GRAMMAR OF TEXTILE DESIGN

H. NISBET

617

GRAMMAR

OF

TEXTILE DESIGN

BY

HARRY NISBET

WEAVING AND DESIGNING MASTER, MUNICIPAL TECHNICAL SCHOOL, BOLTON

WITH 490 ILLUSTRATIONS

LONDON
SCOTT, GREENWOOD & SON
8 BROADWAY, LUDGATE HILL, E.C.

CANADA: THE COPP CLARK CO., LTD., TORONTO
UNITED STATES: D. VAN NOSTRAND CO., NEW YORK
1906

PREFACE.

THE *Grammar of Textile Design* is a treatise upon the Fundamental Principles of Structural Design in Woven Fabrics, and the application of those principles in the production of various types of cloth.

It has been chiefly prepared as a text-book for students of weaving and designing in all branches of the weaving trade, and contains much information of practical utility to designers, salesmen, manufacturers and others, to whom a knowledge of the construction, characteristic features and uses of textile fabrics will be helpful.

In the descriptions of fabrics that are produced by the aid of special mechanical devices, these are briefly described and illustrated by scale diagrams, and include descriptions of three types of steel-wire doup harnesses for cross-weaving; a loom for weaving leno fabrics in which warp ends are crossed by a system of douping in *front* of the reed; and a loom for weaving ondulé fabrics in which warp ends, and sometimes picks of weft, are caused to assume undulating or wavy lines in the direction of warp, or weft, respectively.

HARRY NISBET.

BOLTON, *October*, 1906.

CONTENTS.

CHAPTER IV.

Diamond and Kindred Weaves.

CHAPTER V.

Bedford Cords.

CHAPTER VI.

Backed Fabrics.

CHAPTER VII.

Fustians.

CHAPTER VIII.

Terry Pile Fabrics.

CHAPTER IX.

Gauze and Leno Fabrics.

CHAPTER X.

Tissue, Lappet and Swivel Figuring; also Ondulé Effects, and Looped Fabrics.

CHAPTER I.

INTRODUCTION.

General Principle of Fabric Structure and the Use of Design Paper.

§ 1. All woven fabrics are composed of at least two distinct series of threads respectively termed "warp" and "weft". Warp threads lie lengthwise of the fabric, parallel with the selvedges (self edges), and weft threads, also termed "picks" of weft, traverse at right angles to warp threads. During the operation of weaving, warp threads are simultaneously withdrawn from their source as a continuous sheet or layer of evenly distributed threads that are spread out to the required width of cloth; whereas weft is (with exceptional instances) inserted only one thread or "pick" at a time, by means of a shuttle which places a continuous thread in successive parallel lengths, extending across the entire width of cloth between the selvedges, around which the weft returns for each successive "pick".

§ 2. The interlacement of warp and weft threads is effected by dividing or separating (in a prearranged order for each pick of weft), the sheet of warp ends into two separate and distinct layers, one above the other (seen thus , when viewed from the end of a loom) to form an opening or division termed a "shed". A shuttle, carrying a supply of weft in the form of a "cop," or on a bobbin or quill, is then projected through the "shed" to leave a trail of weft between the two layers of warp ends. These subsequently close upon the "pick" of weft which is "beaten up" or pushed by the reed to its ultimate place in the fabric, of which it becomes an integral part. Successive picks of weft are similarly inserted

in successive "sheds" of different formation produced by separating warp ends in different orders, and according to a prearranged scheme of interweaving warp and weft, as represented by the design. After each pick is inserted, it is beaten up to its appointed place close to its predecessors, and thus is a textile fabric evolved in accordance with some definite scheme or plan of interweaving which constitutes the design.

§ 3. This mode of interlacing two distinct series of threads constitutes the chief and essential principle governing the construction of every type and variety of woven fabrics irrespective of the special division to which they belong. The particular order or scheme of interweaving those threads constitutes a minor principle of fabric structure that becomes the distinctive and characteristic feature of the class of fabrics embodying it. It is the diversity of schemes of interweaving warp and weft that gives rise to an almost infinite variety of textile fabrics, an exact classification of which would be an extremely difficult, if not impossible, task. This difficulty is greater from the circumstance of many fabrics being each known by a variety of trade names not only in different parts of the same country, but even in the same locality.

Under these circumstances the value of such a classification would be nullified, inasmuch as it could not be of general application; otherwise it would greatly facilitate reference by employing a definite term to signify a particular type or variety of fabric. All these varieties, however, may be classified under comparatively few chief divisions, each representing distinct types of fabrics known by technical descriptions and names more or less universally recognised. Each type is characterised by some special constructive element which distinguishes it from other types, and, as a rule, specially adapts it for particular uses. The present treatise is devoted to describing the characteristics of the principal types of fabrics and of their chief varieties and modifications; also the principles governing their construction, and the preparation of designs for them; the chief purposes for which they are employed, and other helpful information of a practical character relating to their manufacture.

§ 4. Textile design is of two kinds, namely (1) structural, and (2) decorative. The first relates to the specific manner in which warp and weft threads are interlaced, by which is evolved *woven design*, which constitutes the technique of fabric structure. The second relates to the scheme of ornamentation by which a textile fabric is decorated, which is also more or less dependent upon woven design. It is the object of this book, however, to demonstrate the fundamental principles of structural or woven design, which may be aptly described as the "Grammar of Textile Design".

A textile fabric may contain only one element of woven design and yet be profusely embellished without having recourse to colour. Many white and grey linen and cotton, and also white silk, damask and brocade fabrics, are good examples of that class. The construction of such fabrics, and of damasks in particular, is frequently based upon some simple elementary weave which is simply reversed to develop the figure and ground portions, thereby causing warp to preponderate on the surface in some parts, and weft in others ; hence the contrasting tones of light which enable the figure and ground portions to be distinguished. The most elaborately decorated fabrics will oftentimes be found to contain not more than three or four different varieties of simple weaves effectively introduced in the scheme of decoration ; whilst most fabrics employed for domestic purposes, and many others, contain but one element of design of a simple character and specially suited for a specific purpose. An examination of such fabrics will show that warp and weft are interwoven in some simple definite order or sequence that occurs with perfect regularity throughout the entire fabric.

Excepting by the employment of colour, it would frequently be impossible to clearly distinguish the various forms and details of an elaborate design, were it not that a designer has at his command an almost unlimited choice of fundamental weaves by which he may develop its various parts to obtain contrast and variety of effect. Hence, it is equally if not more important that a textile designer should be conversant with the principles of fabric structure, as that he should be an artist and expert draughtsman.

It is important to observe that in all examples of designs contained in this book, filled or shaded squares, or other symbols, on design or point paper, signify that warp threads are *over* weft, wherever those marks are placed, and blank squares signify weft passing over warp. This warning is given in consequence of some writers observing the reverse practice ; but it is quite immaterial whichever is adopted, so long as it is specified.

Use of Design Paper.

§ 5. It is also expedient, at this stage, to explain the use of squared paper on which textile designs are prepared. This is ruled with two sets of lines crossing at right angles to form a series of rectangular spaces. At *regular intervals apart* thicker lines, called "bar lines," are ruled in both directions to form large *squares* termed " bars ". These large squares, or "bars," enclose a number of smaller rectangular spaces which may be either in equal numbers in both directions, or there may be more or less divisions in either direction, uniformly, according to the ratio of warp ends to picks per inch in cloth. In one direction, however, the thicker lines are ruled at regular intervals of either eight or else twelve spaces, to conform to standard conditions in the construction of Jacquard machines, in which needles and hooks are (with exceptions) arranged in rows of either eight or else twelve. The thicker lines also incidentally facilitate the counting of spaces when setting out a Jacquard design ; and they also serve as an index or guide to a card-cutter, as he "reads off" a design and records it by punching holes in the pattern cards. For the present purpose, however, it is sufficient to state that, excepting when employed for designs for certain compound fabrics, the narrow divisions on design paper correspond, in one direction, to warp ends, and in the other direction to picks of weft. If the number of spaces between two bar lines are alike in both directions, as 8 × 8 or 12 × 12, either series of divisions may represent either series of threads ; but if the number of divisions are not alike each way, those of which there are either eight or twelve spaces in a "bar" must represent warp ends, according to the index of the Jacquard machine for which the design is intended. The ratio

of warp and weft spaces in a bar should, however, correspond as nearly as practicable to the ratio of warp ends and picks per inch in the *finished fabric*, in order to ensure the correct shape of figures in a pattern. For example, if a design is to be prepared for a fabric that will contain eighty warp ends and sixty picks per inch, to be produced by means of a 400's Jacquard machine, the proper counts of design paper for it is that ruled 8×6 divisions to each "bar": and for a 600's Jacquard machine, that ruled 12×9 is the proper counts. By placing a dot in a small square, it signifies that the corresponding warp end must be raised above the corresponding pick of weft in cloth; and a blank square signifies that weft must pass over warp at the parts indicated.

CHAPTER II.

THE PLAIN OR CALICO WEAVE AND ITS MODIFICATIONS.

§ 6. The "plain," "calico" or "tabby" weave, as it is variously described, is the most simple and elementary combination of two series of threads employed in the construction of textile fabrics; albeit, it produces a relatively stronger fabric than is obtained by any other simple combination of threads, excepting that of "gauze" or "cross-weaving".

The minor principle observed in the construction of plain cloth is the interlacement of any two contiguous threads of either warp or weft in an exactly contrary manner to each other, with every thread in each series passing alternately under and over consecutive threads of the other series uniformly throughout the fabric. By this plan of interlacement, every thread in each series interweaves with every thread in the other series to the uttermost extent, thereby producing a comparatively firm and strong texture of cloth. Also, a complete unit of the plain weave occupies only two warp ends and two picks of weft, as represented in Fig. 1, which is the design (as indicated on design paper) for that weave. The rectangle enclosing two shaded and two white squares indicates one unit of the design, which is repeated sixteen times. The construction of plain cloth is clearly demonstrated by means of Figs. 2, 2A and 2B, which are diagrams representing a plan, a transverse section (crosswise), and a longitudinal section (lengthwise) respectively of that cloth.

Firmness of Texture.

§ 7. The degree of firmness of texture in woven fabrics is largely determined by the manner of interweaving warp and weft, and will be greater or less according as the two series

of threads interlace more frequently or less frequently, respectively. Thus, if two pieces of cloth are woven from similar warp and weft, and with the same number of warp ends and picks per inch—(*a*) with the plain weave, in which threads interlace to the uttermost extent, and (*b*) with any other weave —the latter would be less firm, and therefore of weaker texture than the former, because the threads composing it would be bent in a lesser degree than those of the plain weave, thereby causing them to be less firmly compacted. For this reason it is important that the counts of warp and weft, the number of warp ends and picks per inch, and the weave, should be properly proportioned, in order to obtain the best results. This

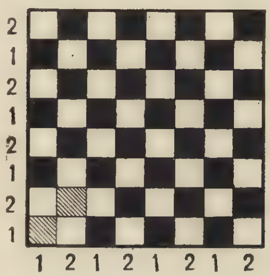


Fig. 1.—Plain or Tabby Weave.

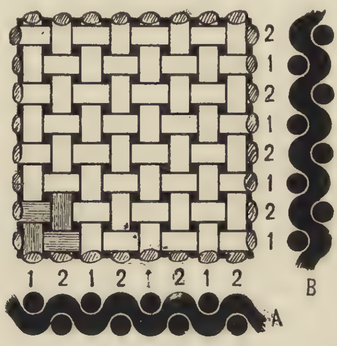


Fig. 2.—Plan and Sections of the Tabby Weave.

phase of fabric structure, however, does not come within the scope of this treatise.

Notwithstanding the very simple character of the plain weave, it is produced in a great variety of forms and textures, possessing totally different characteristics, which adapt it for specific purposes. Apart from those arising from the employment of different textile materials, and also without in any way departing from the true principle of the plain weave, as defined in § 6, the varieties of texture and form are produced (*a*) by the employment of different counts of yarn for different fabrics ; (*b*) by the employment of warp of one counts and weft of another counts in the same fabric ; (*c*) by the employment of warp or

weft, or both warp and weft, of different counts in the same fabric ; and (*d*) by subjecting some warp ends to a greater degree of tension than others during weaving.

Variety of Texture.

§ 8. The term "texture" is here used to signify the general qualities of a fabric as regards material, counts of yarn, relative

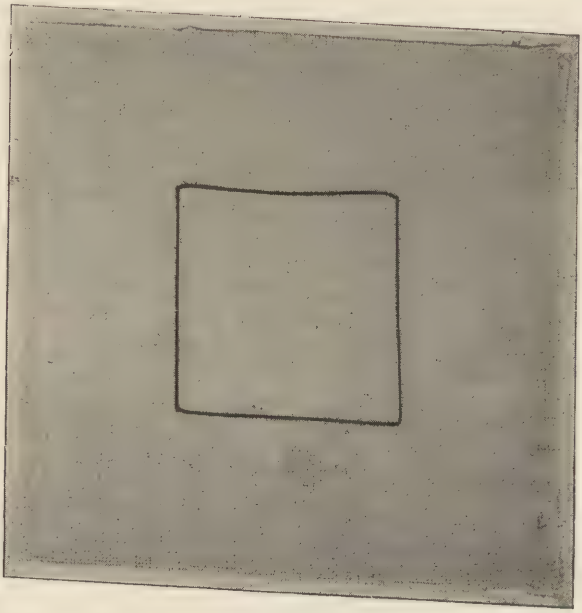


Fig. 3.—Plain Calico Cloth.

density of threads, weight, bulk, how it feels when handled, and other properties peculiar to woven fabrics. Plain cloth is produced in a greater variety of textures than perhaps any other weave, and varies from the fine, light, open and airy texture of muslin, to that of coarse and heavy hempen sackcloth. When produced from cotton yarn of counts ranging in different fabrics from about 20's to 160's for both warp and weft, and containing from about 40 to 160 warp ends and picks per inch, it is

known as *calico*—a fabric produced in great quantities, and extensively used in both a grey (*i.e.*, of the natural colour of cotton) and a bleached state, for a variety of domestic purposes. A true plain cloth is one in which the counts and qualities of both warp and weft, and also the number of warp ends and picks per inch, are similar. When these conditions exist either

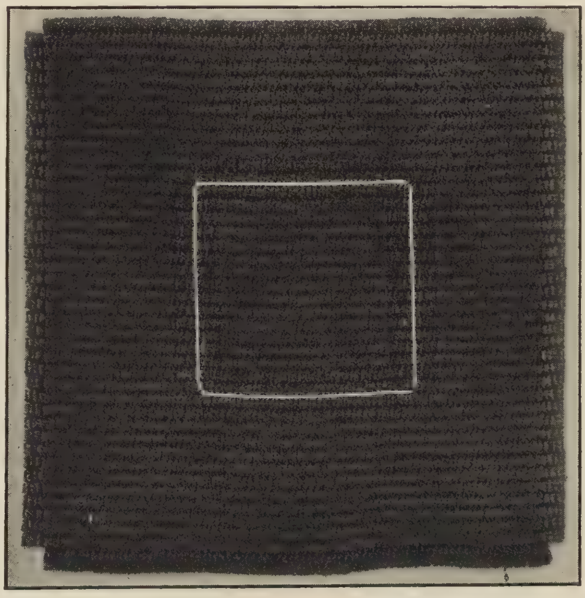


Fig. 4.—Simple Warp-ribbed Cloth.

precisely or approximately, whether the texture is fine or coarse, light or heavy, it will produce a general evenness of surface, resulting from warp ends and picks each bending or yielding to each other's influence in a corresponding degree. Fig. 3 illustrates an example of grey "calico" of medium quality, containing seventy-two warp ends of 36's T., and sixty-two picks of 30's W., per inch. (The rectangle encloses one square inch of cloth.)

Variety of Form: Ribbed Fabrics.

§ 9. The least variation of form in the plain weave is effected by employing warp and weft of sufficient difference of counts and density of threads to produce a ribbed or corded effect throughout the fabric. The ribs or cords will lie in the direction

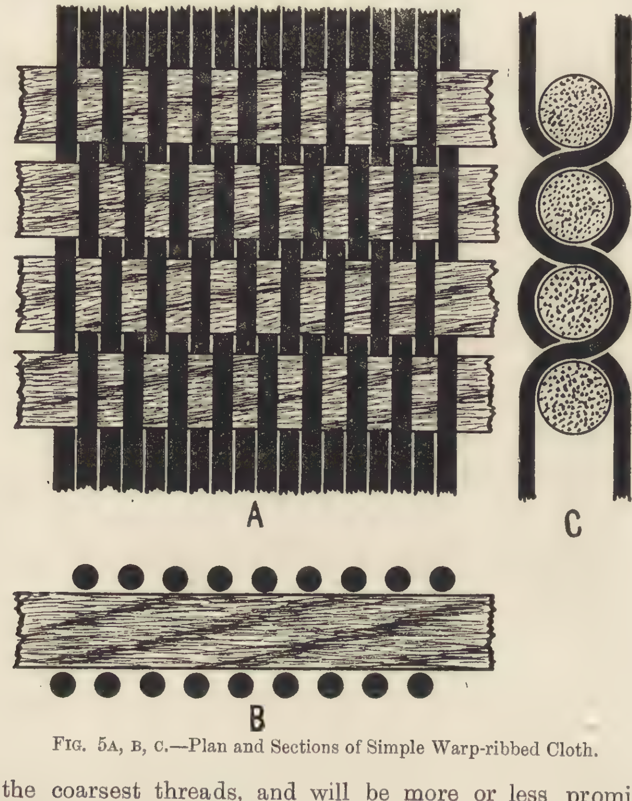


Fig. 5a, b, c.—Plan and Sections of Simple Warp-ribbed Cloth.

of the coarsest threads, and will be more or less prominent according as the difference in counts between the two series of threads is greater or less, respectively. Fig. 4 illustrates an example of cloth woven from comparatively fine warp and coarse weft, which develop a series of ribs lying in the direction of weft, and known as *warp* ribs. By reversing these conditions, the ribs would lie in the direction of warp, in which case they

would be termed cords, or *weft* ribs. In either case the rib formation is entirely due to the non-yielding quality of the coarser and stronger threads, and the yielding quality of the finer and weaker threads, which perform all the bending under and over the coarser threads. This is clearly illustrated by diagrams, Figs. 5A, 5B and 5C, which are a plan, transverse

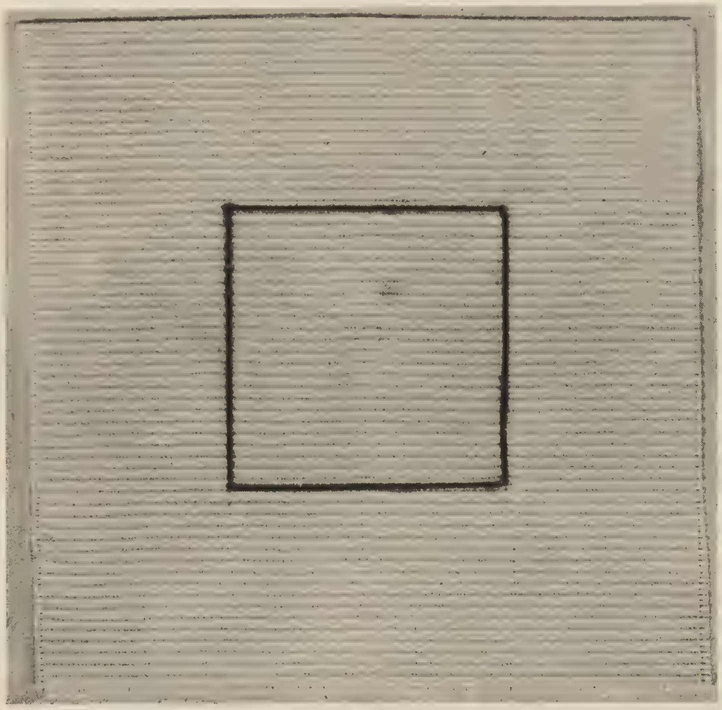


FIG. 6.—A Third Example of Warp-ribbed Cloth.

section and longitudinal section, respectively, of the warp-ribbed cloth, Fig. 4, which contains sixty-eight warp ends and sixteen picks per inch. (The rectangle encloses one square inch of cloth.)

Another variety of the plain weave is illustrated in Fig. 6. In this example the rib formation results not entirely from any great difference between the counts of warp and counts of weft,

as in the previous examples, but only partly from that circumstance, and, in a greater measure, in consequence of alternate warp ends being held at a considerably greater degree of tension than intermediate warp ends, during the operation of weaving. This difference of tension between what are virtually two series of warp ends—although each series is of exactly the same kind of yarn—necessitates the use of two warp beams —one containing, say, all odd-numbered warp ends, and the other all even-numbered warp ends. Only one system of weft, which is of coarser counts and much softer than the warp, is employed. In consequence of some warp ends being held taut during weaving they are prevented from bending, and therefore lie in an almost perfectly straight line throughout the length of cloth. This causes picks of weft to lie perfectly straight and in

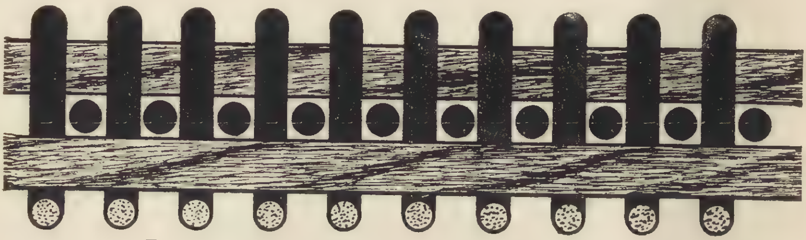


FIG. 6A.—Transverse Section of Cloth represented by Fig. 6.

two planes, above and below taut warp ends, and so form prominent ribs on both sides of the cloth; whilst slack warp ends freely bend over and under picks of weft, to bind them firmly in position, as indicated in transverse and longitudinal sections, diagrams Figs. 6A and 6B.

The amount of contraction of warp during weaving, in cloth of this description, will vary according to the counts of weft and number of picks per inch, as well as according to the degree of tension upon warp. The contraction will be greater or less in proportion to the thickness of weft and the number of picks per inch in cloth. In the example, Fig. 6, which contains eighty-four warp ends of 30's T. and forty-six picks of 16's W. per inch, the amount of contraction is equal to $2\frac{1}{3}$ per cent. for taut, and $33\frac{1}{3}$ per cent. for slack warp ends. (The rectangle encloses one square inch of cloth.)

§ 10. One more variety of ribbed cloth, based on the principle of the plain weave, will serve, along with the two previous examples, to demonstrate its variation of form in the development of ribbed fabrics. This is the well-known "repp" cloth,

FIG. 6B.—Longitudinal Section of Cloth represented by Fig. 6.

illustrated in Fig. 7, so extensively employed for window blinds in railway carriages and other vehicles, and for the upholstering of furniture. In general appearance it closely resembles the ribbed cloth illustrated in Fig. 4; but a close inspection of both examples will reveal a great difference in their construction and

texture—the repp cloth being much firmer and stronger than the ribbed cloth.

In the production of repp cloth, as illustrated in Fig. 7, two distinct series of both warp and weft are employed—the counts and character of each series being such as to develop a series of very prominent and sharply defined ribs in the direction of weft. The warp series comprise two counts of yarn—one fine

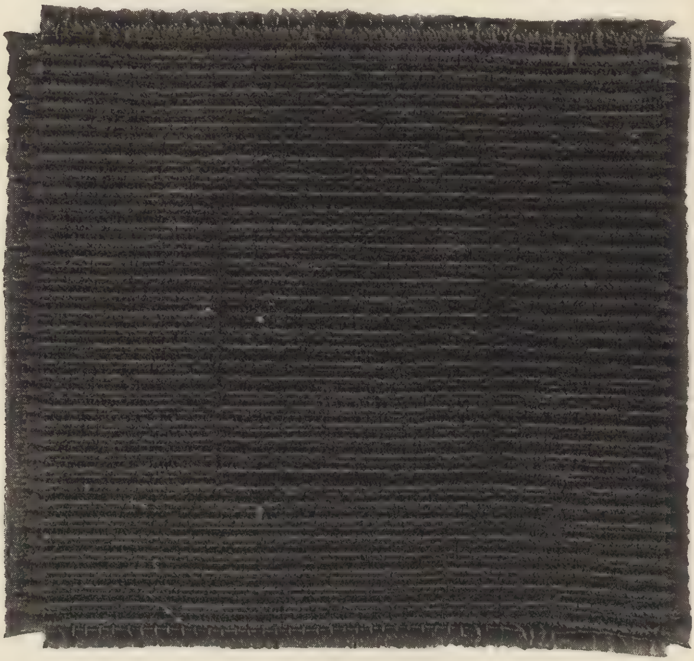


FIG. 7.—Repp (warp-ribbed) Cloth.

and strong, which is held at great tension during weaving, and the other coarse and soft, which is held at a less degree of tension, to enable it to easily yield and bend over coarse and under fine picks of weft. Each series of warp ends is wound upon a separate warp beam to allow of a different rate of contraction during weaving. They may be arranged in the harness and reed in the order of one fine and one coarse warp end

alternately; but a superior rib will be produced by running two *medium* warp ends together, as in the example, Fig. 7, and as indicated in plan, Fig. 8A. The weft series also comprise two counts of yarn—one fine and strong, similar to the fine warp, and the other very coarse and strong. These are inserted, one fine and one coarse pick alternately, thereby requiring a loom

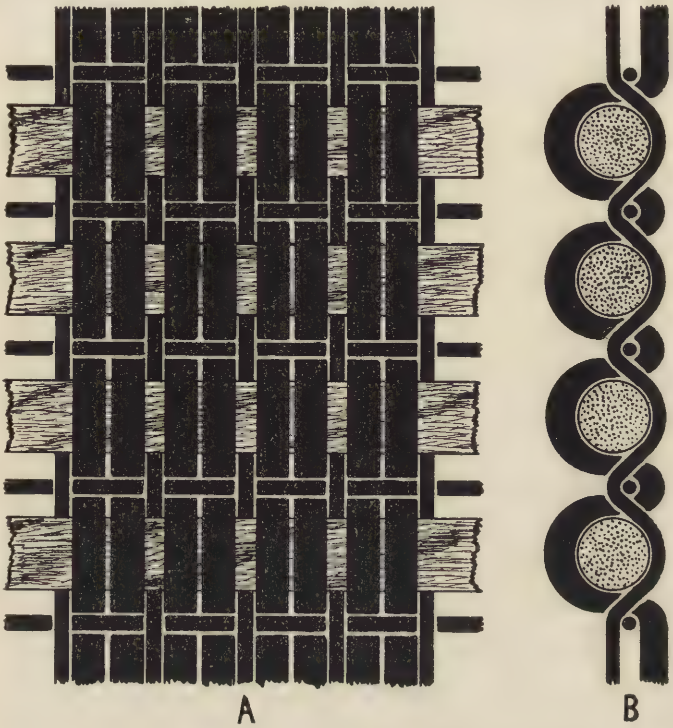


FIG. 8A, B.—Plan and Longitudinal Section of Repp Cloth.

with two shuttle boxes at each end of the sley, and a "pick-and-pick" picking motion, *i.e.*, one capable of picking twice, or more than twice, in succession, from each side of a loom. When coarse picks are inserted, all medium warp ends only are raised to form ribs; and when fine picks are inserted, all fine warp ends only are raised, thereby forming deep furrows by binding down all medium warp ends between the coarse

picks, as seen in longitudinal section, diagram, Fig. 8B. The sample of repp cloth illustrated in Fig. 7 contains $21 \times 2 = 42$ medium, and 21 fine warp ends per inch; and 17 coarse and 17 fine picks per inch. (The rectangle encloses one square inch of cloth.)

§ 11. In the foregoing examples of ribbed fabrics, the ribs of the respective pieces are of uniform size, and occur in immediate succession, thereby producing a general evenness of effect and uniformity of texture throughout the entire piece of cloth. Cords or ribs are, however, frequently employed as a simple means of ornamenting what would otherwise have been entirely plain fabrics, but which are made to assume a variety of decorative effects of a very pleasing character. Such effects are, of course, confined to stripes, running either up or across the cloth, and to checks. Stripes may be formed in an upward direction in a plain calico fabric by disposing comparatively coarse warp ends or else groups of warp ends at either regular or irregular intervals apart, according to the effect desired. Such threads may be either of uniform counts, to produce plain ribs, or of different counts, to produce variegated ribs. By inserting coarse picks of weft instead of coarse warp ends in the manner just described, stripes would be formed across the piece; and by introducing coarse threads in both series, checks of great variety may be formed. A familiar example of this method of embellishing a plain fabric is that of a cambric pocket handkerchief, bordered either by a series of thick threads or by placing two or more fine threads together side by side to form cords.

§ 12. The development of ribs and cords is not dependent upon the employment of coarser threads in one series than in the other. They may be formed in fabrics composed of warp and weft of uniform counts, by causing two or more threads of one series (according to the required prominence of rib) to lie closely side by side, so as to virtually constitute a coarse thread composed of several strands not twisted together, and interweaving such groups of threads with separate threads of the other series. If threads are grouped in uniform quantities throughout, the ribs will be of uniform size; but if grouped in

irregular quantities, a series of variegated ribs will be produced. By this method the rib formation is caused by the combined resistance of the grouped threads, which lie straight, thereby

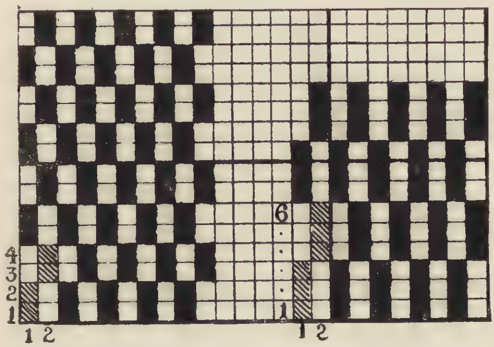


FIG. 9. FIG. 10.

compelling the separate threads of the other series to yield and bend under and over them, in accordance with the principle of fabric structure which determines that the relative

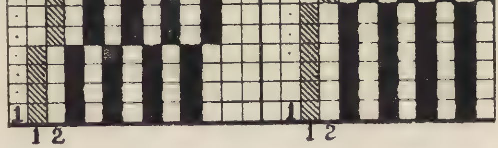


FIG. 11. FIG. 12.

prominence of threads *diminishes* in proportion to the amount of bending performed by them in cloth.

§ 13. Simple ribs of various sizes may be formed in the direction of weft by separating alternate warp ends (as in the plain calico weave) and inserting two or more picks of weft in the

same sheds of warp. Figs. 9 to 12 are designs for this class of rib weaves containing two, three, four and six picks respectively, in each shed. Each design repeats on two warp ends, and such number of picks as are contained in two ribs, namely, four, six, eight and twelve respectively. In the production of these or

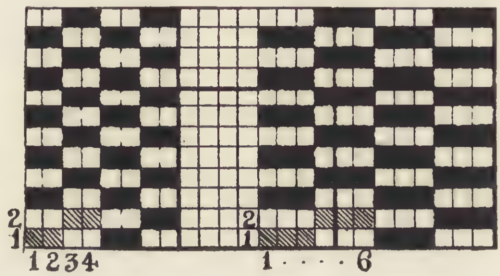


Fig. 13. Fig. 14.

other weaves, in which several successive picks are inserted in the same shed, it is necessary to furnish a loom with a selvedge motion, to operate selvedge warp ends in a different order from that of warp ends forming the body of the fabric, and thereby

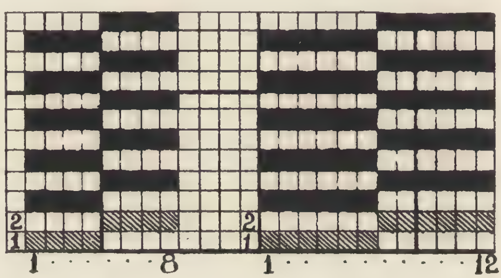


Fig. 15. Fig. 16.

prevent picks of weft from being pulled backward into the shed when a shuttle passes through the same shed for several picks in succession.

§ 14. Simple cords may be formed in the direction of warp by raising warp ends in uniform groups of two or more threads which may pass through heald eyes either separately or in

groups. Figs. 13 to 16 are designs for cords in which two, three, four and six warp ends respectively are grouped together. Each design repeats on as many warp ends as are contained in two cords, and two picks of weft. Since each pick is contained

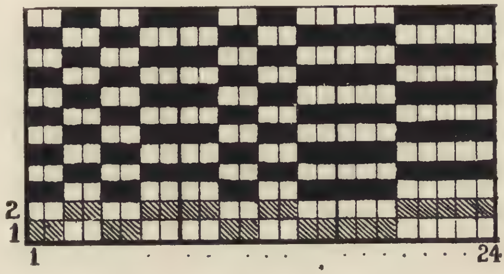


FIG. 17.

in a separate shed, it is unnecessary to employ a special selvedge motion when weaving those designs.

It was stated in § 12 that variegated cords or ribs may be formed by an irregular system of grouping threads either warp way or weft way respectively. It should be observed, however,

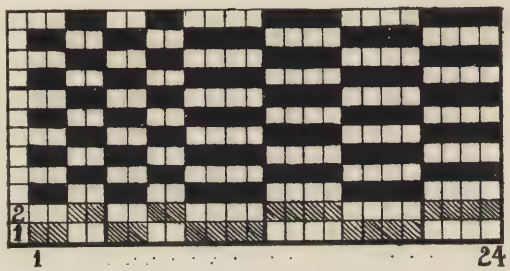


FIG. 18.

that much greater scope is afforded in this respect by grouping warp ends, than by grouping picks of weft; also that variegated cords (warp way) may be more economically produced than variegated ribs (weft way). This arises from the fact that cords of any variety may be formed in a plain loom by simply varying the drafting of warp ends through the healds; whereas variegated ribs would require to be woven in a loom mounted with a

dobby or even a small Jacquard machine (for large patterns) and furnished with a selvedge motion. Also, in addition to the extra cost of such looms, a higher rate of wages would have to be paid to weavers engaged upon them. Figs. 17 to 20 are

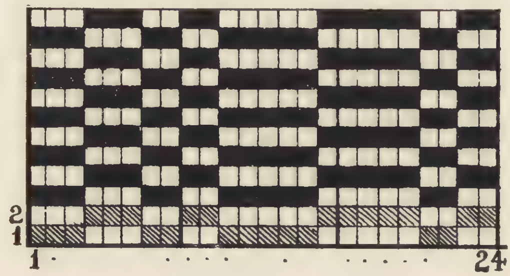


FIG. 19.

designs for variegated cords, each repeating on twenty-four warp ends and two picks. By turning those designs on their side they become variegated ribs, repeating on two warp ends and twenty-four picks.

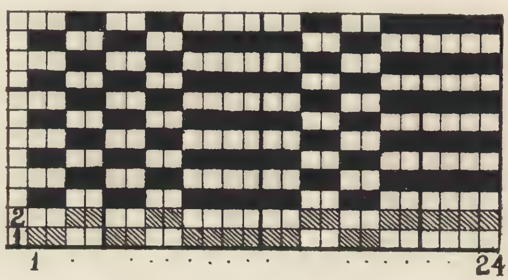


FIG. 20.

Matt Weaves.

§ 15. Simple matt weaves are those in which groups of two or more contiguous warp ends and picks interlace with each other so as to produce a chequered or dice effect, as represented in designs, Figs. 21, 22 and 23. The simplest of these weaves

is that known as a two-and-two or four-end matt weave indicated in Fig. 21, in which warp ends and picks interweave in pairs throughout the fabric, on the principle of the plain weave. This matt weave is extensively adopted for a great variety of

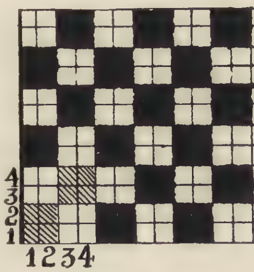


Fig. 21.

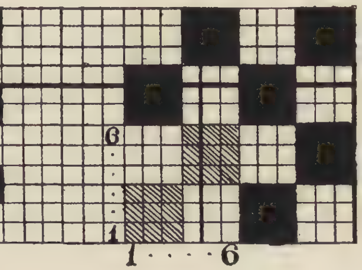


Fig. 22.

fabrics, of which dress materials, shirtings, sailcloth (for ships' sails), and "duck" cloth are, perhaps, the more notable examples. Figs. 22 and 23 are designs for three-and-three (six-

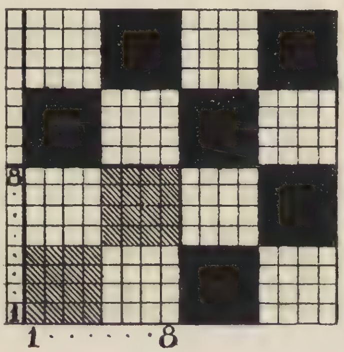


Fig. 23.

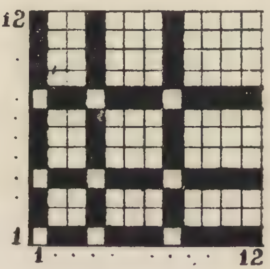


Fig. 24.

end) and four-and-four (eight-end) matt weaves respectively. When these and larger matt weaves are employed, the number of warp ends and picks per inch in cloth should be proportionately increased, otherwise they would produce fabrics of an open and flimsy texture, in which the threads would become

easily displaced, in consequence of the very few intersections made by them.

§ 16. Variegated matt weaves are developed by combining irregular groups of warp and weft threads, after the manner

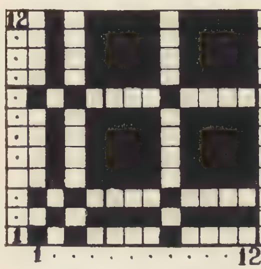


Fig. 25.

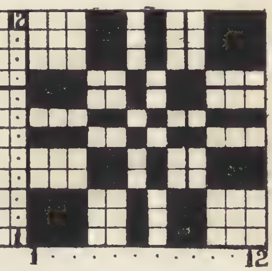


Fig. 26.

indicated in Figs. 24 to 29, of which the first three are designs repeating on twelve, and the last three, on sixteen warp ends and picks. They may be formed with weft preponderating on

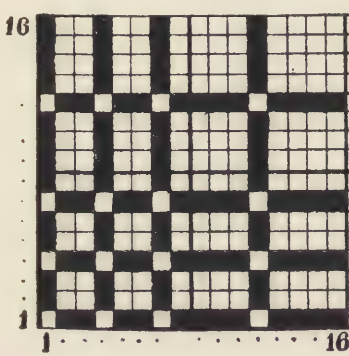


Fig. 27.

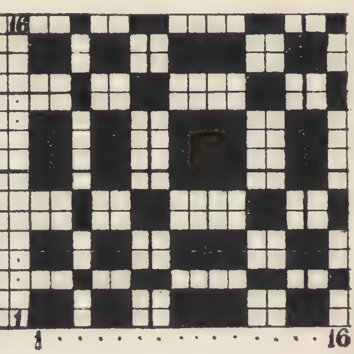


Fig. 28.

the face, as Figs. 24 and 27; with warp preponderating on the face, as Figs. 25 and 28; or they may be designed as true counterchange or diaper patterns, as Figs. 26 and 29, in which warp and weft are exactly counter to each other and in equal quantities on both the face and back of the fabric. It will be

observed that in these designs, as in all others of the same class, there are only two orders in which warp ends interweave with weft, thereby requiring not more than two healds for their pro-

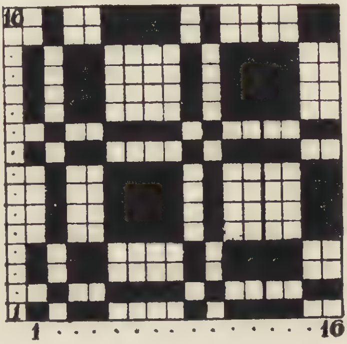


FIG. 29.

duction in cloth, although the healds would require to be operated by a dobby or other shedding device, for designs repeating on such number of picks as are beyond the reasonable scope of tappets.

CHAPTER III.

TWILL AND KINDRED WEAVES.

§ 17. Twill weaves form a distinct departure from any of the foregoing, and they constitute a most useful variety of weaves extensively employed in the construction of numerous classes of fabrics. They exist in endless varieties of form, and are based on a simple principle of design; but whatever particular appearance they assume, they are generally characterised by a series of more or less pronounced diagonal wales or ridges and furrows, with either warp or weft preponderating, or in equal quantities, on the face of the fabric. The twill may be produced continuously either from right to left (*i.e.*, *sinistrally*), as in Fig. 30; or from left to right (*i.e.*, *dextrally*); or again, it may be produced in reverse directions in the same fabric, as desired. The variety of twill weaves is so considerable as to render an exact classification of them impossible. For the present purpose, however, they may be broadly divided into six chief varieties, namely: (1) continuous twills; (2) zigzag or wavy twills; (3) rearranged twills, including satin weaves and "corkscrew" twills; (4) combined twills; (5) broken twills; (6) figured and other twill weaves of an indefinable character. Each of these divisions may be subdivided into (*a*) warp-face twills; (*b*) weft-face twills; and (*c*) warp and weft-face twills, in which warp and weft are in either equal or unequal quantities on the face of the fabric.

1. Continuous Twills.

§ 18. (*a*) *Warp-face Twills.*—These are formed by raising all warp ends, excepting one, in each repeat of the pattern, for each pick, and stepping one warp end in consecutive rotation (to the

right or left, according to the required direction of twill) as successive picks are inserted. These will develop a series of diagonal wales or ridges of warp, separated by furrows formed by single stitches of weft. Twill weaves may be formed on any

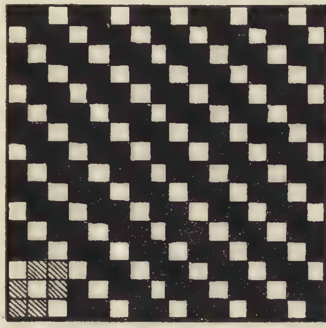


FIG. 30.

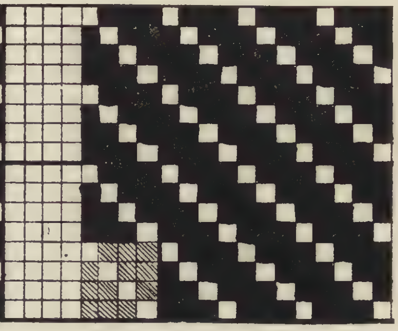


FIG. 31.

number of warp ends and picks, from three upwards. Figs. 30 to 35 are designs for warp twills repeating on three to eight warp ends and picks respectively, and will be sufficient to indicate the principle of their construction.

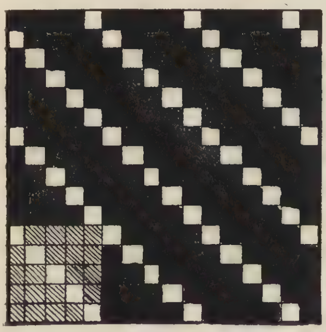


FIG. 32.

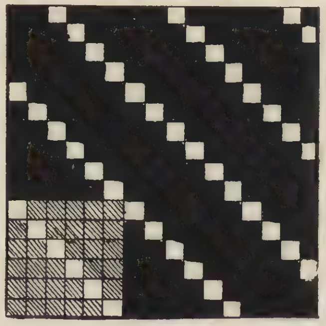


FIG. 33.

§ 19. (*b*) *Weft-face Twills.*—These are produced by reversing the conditions stated in § 18, by raising one warp end only, in each repeat of the pattern, for each pick, and proceeding in a similar manner to that described for warp-face twills. This will produce a series of diagonal ridges of weft separated by single

stitches of warp, as indicated in designs, Figs. 36 to 41, which are for weft twills repeating on three to eight warp ends and picks respectively.

§ 20. (*c*) *Warp and Weft-face Twills.*—These may be formed with either equal or unequal wales of warp and weft arranged

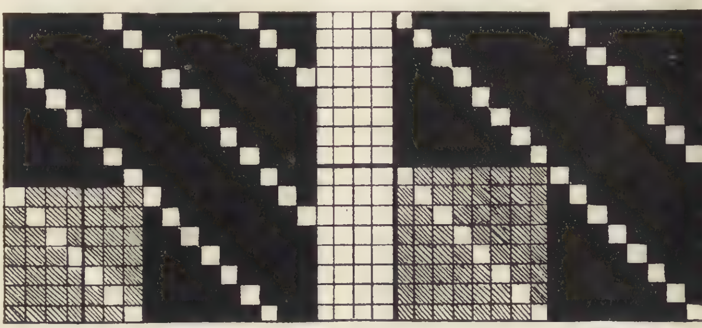


Fig. 34. Fig. 35.

alternately. If the wales are equal, that is, if both warp ends and picks pass over and under the same number of threads uniformly, warp and weft will necessarily be in equal quantities

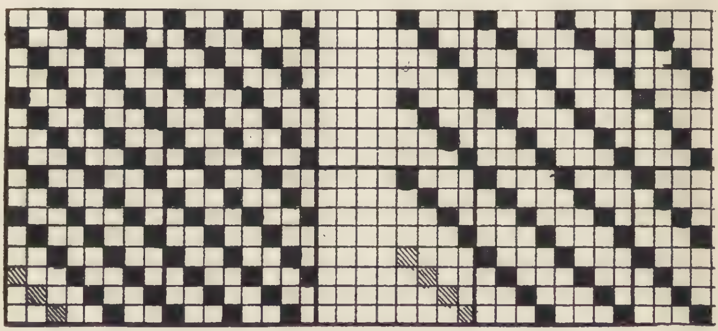


Fig. 36. Fig. 37.

on both the face and back of the fabric ; but if the wales are unequal, warp and weft may be either in equal or unequal quantities on the face and back of cloth. Equal wales are formed by alternately raising and leaving down equal groups of two or more warp ends for each pick, and stepping one warp

end in consecutive rotation as successive picks are inserted. The least of this class is that variously known as the "two-and-two" $\left(\frac{2}{2}\right)$, the "Harvard" and the "Cassimere" twill given in Fig. 42, which repeats on four warp ends and picks. This is a

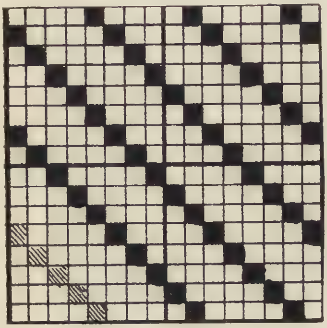


Fig. 38.

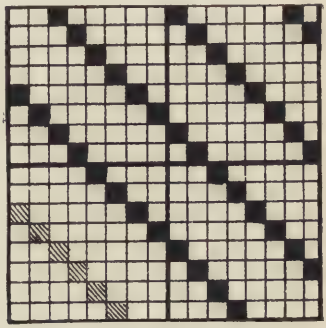


Fig. 39.

very useful weave, and one that is perhaps more extensively employed than any other of its class. The principle on which it is constructed is conducive to the production of firm and

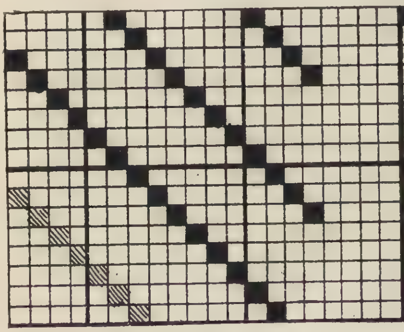


Fig. 40.

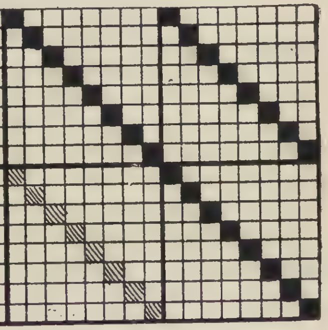


Fig. 41.

strong cloth of comparatively light texture. These qualities arise from warp and weft interlacing with such frequency and in such a manner as to permit of the threads of each series lying close together. On examining this weave, it will be seen that alternate threads of warp or weft interweave in an opposite

manner at the same time; that is, when one is above, the other is below, the same threads of the other series, although all threads in both series interweave in a precisely similar manner to each other. For these reasons, this simple twill weave is

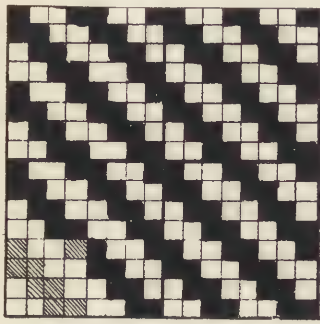


FIG. 42.

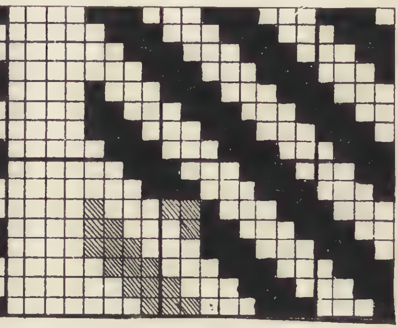


FIG. 43.

capable of producing a firm, close and compact texture, and is one of the most useful weaves to a textile designer. Figs. 43 and 44 are two other examples of twill weaves having warp and

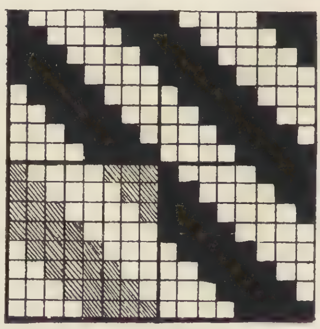


FIG. 44.

weft in equal quantities on both the face and back of cloth. Fig. 43 is a six-end $\left(\frac{\quad 3}{3 \quad}\right)$ twill, and Fig. 44 an eight-end $\left(\frac{\quad 4}{4 \quad}\right)$ twill. It will be observed in Fig. 43 that the first and fourth threads in either series, counting from any thread, interweave in an opposite manner to each other at the same time. Like-

wise with the first and fifth threads in Fig. 44. Knowledge of these features is valuable to a designer in the development of broken twills, and other designs having a twill foundation.

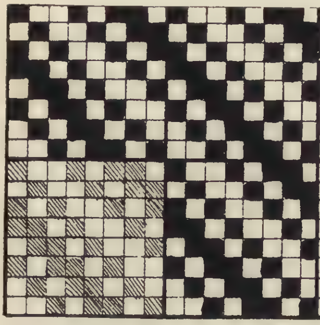


FIG. 45.

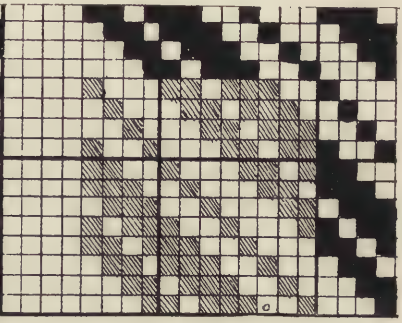


FIG. 46.

Figs. 45, 46 and 47 are designs for twill weaves to produce unequal wales of warp and weft in equal quantities on both face and back; whilst Figs. 48, 49 and 50 are designs for twills

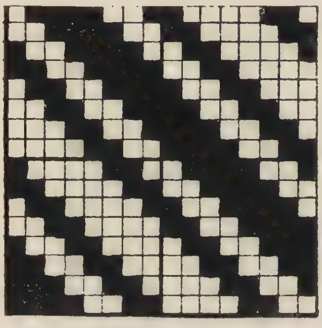


FIG. 47.

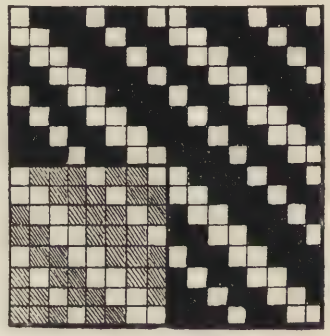


FIG. 48.

having unequal wales of warp and weft, but with warp preponderating on the face. The three designs of each of these latter varieties repeat on eight, twelve and sixteen warp ends and picks respectively.

Before proceeding to describe the second class of twill weaves, as enumerated in § 17, it will be both interesting and instructive

to indicate the main influences affecting the angle, and also the relative prominence, of twills in cloth.

The Angle of Twill.

§ 21. The angle of twill in any continuous twill weave in which the progression is accomplished by advancing one thread

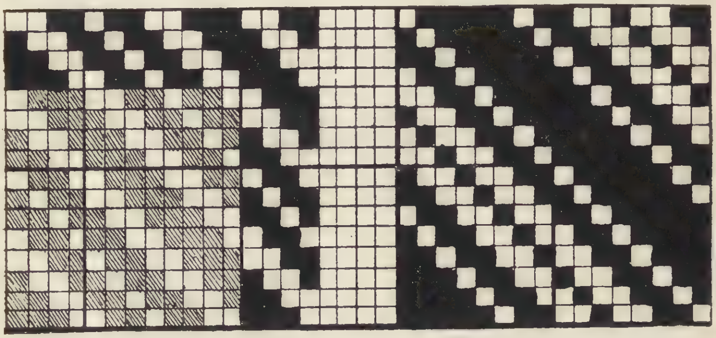


Fig. 49. Fig. 50.

only at a time, with both warp and weft, is determined by the ratio existing between the number of warp ends and picks in a given measurement, say, one inch. If warp ends and picks are

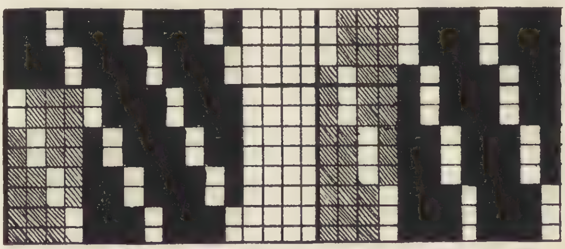


Fig. 51. Fig. 52.

in equal numbers per inch, the angle of twill must necessarily be one of forty-five degrees, irrespective of any difference that may exist between the counts of warp and weft; but if the threads of one series are more numerous than those of the other, the angle

of twill will assume an inclination towards those threads in greater number. Thus, if there are more warp ends than picks per inch, the angle of twill will incline in the direction of warp ends in proportion to the excess of warp ends over picks; but if there are more picks than warp ends per inch, the angle of twill will incline more in the direction of weft. High-angle or low-angle twills may also be formed by advancing two or more threads together in one series, and one thread only in the other series, as in Figs. 51 to 54. If a *high-angle* twill is produced by this method, or if warp ends exceed picks per inch, the twill should be developed with warp, as in Figs. 51 and 52. If

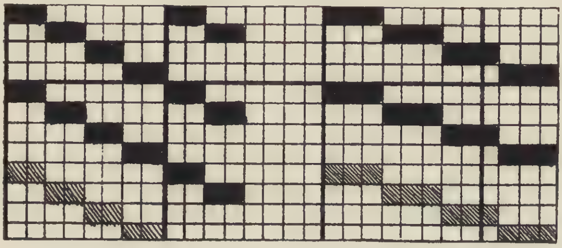


Fig. 53. Fig. 54.

a *low-angle* twill is required, or if picks exceed warp ends per inch, the twill should be developed with weft, as in Figs. 53 and 54.

Influences Affecting the Prominence of Twills and Kindred Weaves.

§ 22. A twill weave will assume either a more or a less pronounced character in cloth, according to different circumstances. The relative prominence of twills is chiefly determined by (*a*) the character of weave; (*b*) the character of yarn; (*c*) the number of warp ends and picks per inch; and (*d*) the direction of twill in relation to the direction of twist imparted to yarn during spinning.

(*a*) *Character of Weave.*—A twill weave will be relatively more pronounced if developed from longer than from shorter floats of yarn; but unless the freer interlacement of threads is

counterbalanced by a proportionate increase in their number per inch, the fabric will be relatively weaker, for reasons stated in § 7. It is to obtain longer floats of yarn that high-angle twills should be developed with warp, and low-angle twills with weft, as explained in § 21. If those conditions were reversed, the twill would lack fulness owing to the short flushes of yarn, as may be readily observed on examining the reverse side of a fabric of this class.

(*b*) *Character of Yarn.*—A more pronounced twill will result from either coarse-spun or soft-spun yarn than from fine-spun or hard-spun yarn; also from folded yarn (*i.e.*, a thread consisting of two or more single strands of yarn twisted together) than from single yarn.

(*c*) *Number of Threads per Inch.*—A twill will be relatively more or less pronounced in proportion to the number of threads per inch.

(*d*) *Direction of Twill in Relation to the Direction of Twist in Yarn.*—If the same twill weave is produced to the left in one fabric, and to the right in another fabric of exactly similar texture, and woven from similar yarn, or (which amounts to the same) if the same twill is produced in both directions in different parts of the same fabric, it will appear to be more pronounced in one direction than in the other, according to the direction of twill in relation to the direction of twist in the yarn composing it. This difference is also observable between the obverse and reverse sides of the same fabric, especially if warp and weft are in equal or in nearly equal quantities on both sides. For example, if a twill inclines to the left (thus \) when viewed obversely, it will incline to the right (thus /) when viewed on the reverse side, albeit the direction of twist in both warp and weft remains the same. Therefore the direction of twill in relation to the direction of yarn twist is different on each side of the fabric, with the result that the twill appears to be more prominent on one side than on the other. In this case, however, the influence exerted by the deflection of the warp line out of a straight course between the breast beam and back rest of a loom (to spread the warp ends and thereby obtain what is termed "cover" in cloth) will be a contributory factor affecting

FIG. 55.—Showing the Face Side of $\frac{2}{2}$ Twill Cloth of Coarse Texture, produced from Folded Warp and Weft twisted sinistrally, or Weft-way (when folded), and with the Twill produced upward from left to right, or dextrally. (Note the prominence of Twill.)

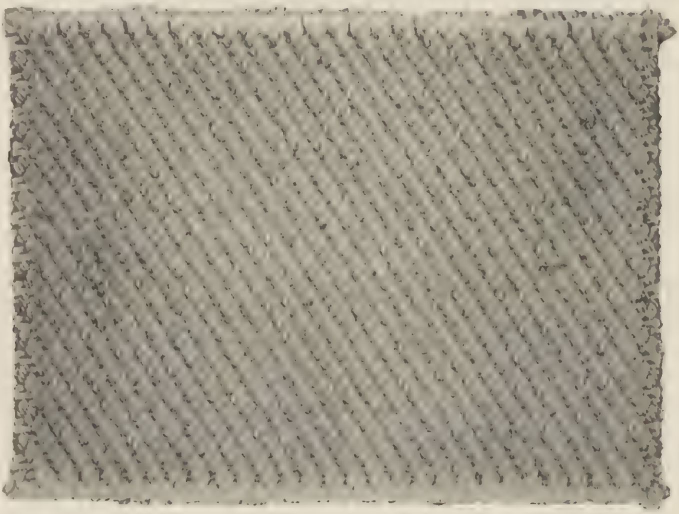


FIG. 56.—Showing the Reverse Side of the piece of Twill Cloth represented by Fig 55. (Note the peculiar inclination of Warp Threads from a straight course, and its effect in subduing the Twill.)

the relative prominence of twill on both sides of a fabric. This circumstance, however, does not entirely account for the difference between the face and back of a twill cloth, otherwise no difference would be manifest between the same twill produced to the right and to the left in different parts of the same fabric.

What actually occurs, is that the series of ridges and furrows in a twill fabric are *more sharply defined* and pronounced if they incline in the *opposite* direction to the twist in yarn with which the *ridges* of twill are formed; and *per contra*, the twill will be *less* prominent if the twill and yarn twist lie in the *same* direction.

§ 23. This peculiar and interesting phenomenon in twill and allied weaves has occasionally engaged the attention of textile experts who have sought to discover its origin; and although various theories have been put forward as probable explanations of it, its true cause is still a matter for conjecture, and cannot therefore at present be definitely stated.

According to one theory, the phenomenon just referred to is attributable to the effect produced by the reflection of light at different angles from the fibres composing the threads, according to the direction in which the fibres lie in relation to the direction of twill. This may *partly* account for the different effects, but it is apparently not the chief factor, as may be easily demonstrated by taking a piece of cloth in which the same twill is produced in both directions, in different parts, and viewing it in a neutral or well-diffused light, when a decided difference will be observed between the twill inclined to the right, and that inclined to the left. The twill in the opposite direction to the twist of yarn will be more distinct than that in the same direction as yarn twist. It would appear, therefore, that the difference is caused either partly or entirely by some influence exerted by the direction of twill upon the twist of yarn. This preconception forms the central feature of another theory based on the assumption that since the spirality of a spun thread is an artificial and not a natural property of such a thread, the fibres composing it subsequently tend, under favourable conditions, to recover their original straight and free condition, thereby causing the thread to untwist, especially when it is subjected to

tensile strain. Hence it is argued that during weaving, when the respective threads are under tension, they tend to untwist in cloth, and consequently roll slightly out of their original perfectly straight course, and assume a more or less oblique inclination between the points where they intersect with other threads, unless means are adopted to prevent or check such tendency by producing the twill in the *opposite* direction to that of yarn twist.

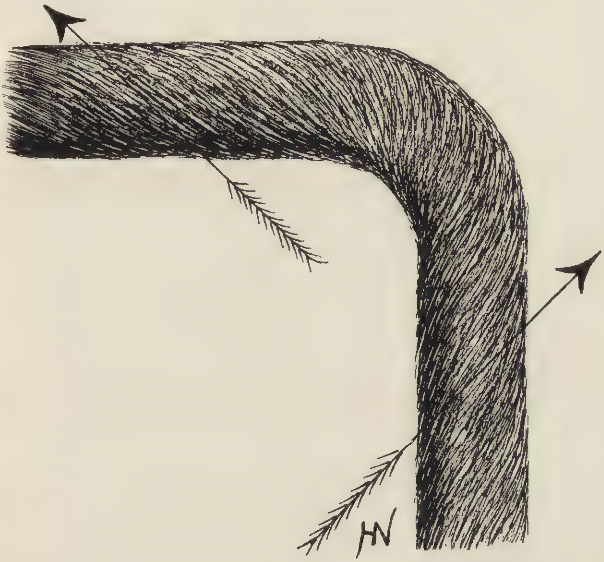


FIG. 57.—Showing a Thread Spun with a Right-hand Twist, or "Twist-way".

§ 24. The different effects of the same twill weave produced in opposite directions in the same fabric are exemplified in a very striking manner by Figs. 55 and 56, which represent portions of the face and back, respectively, of an actual example of grey cotton two-and-two twill cloth, containing thirty-five warp ends per inch of 4/6's yarn ; and twenty-two picks per inch of 4/10's yarn. The single strands of yarn composing the folded threads of both warp and weft are spun "twist" way, *i.e.*, *dextrally*, with the twist or spirality extending upward from left to right, thus /

(when the thread is viewed either suspended vertically, or extending from the observer) and as indicated in Fig. 57; but the doubling twist of the folded thread is in the opposite direction to that of the single-yarn twist (in accordance with usual practice in doubling spinning), namely "weft" way, *i.e.*, *sinistrally*, with the twist inclining from right to left, as indicated in Fig. 58. The twill on the face of cloth inclines to the right, and therefore *opposes* the direction of twist in the warp ends, which are both

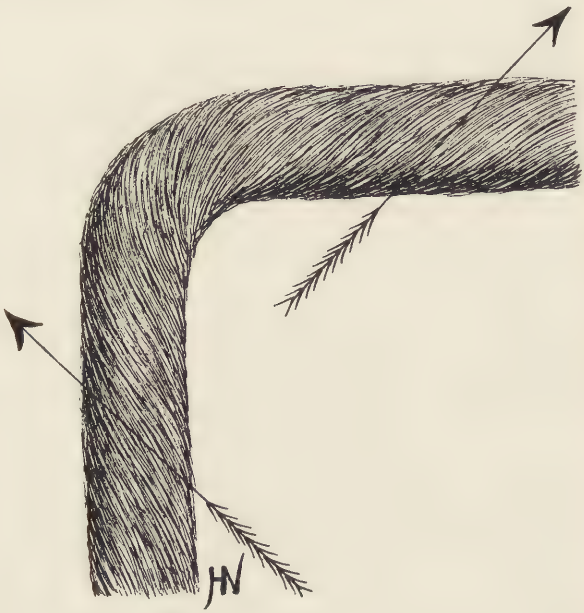


FIG. 58.—Showing a Thread Spun with a Left-hand Twist, or "Weft-way"

coarser and more numerous than picks of weft, and are consequently more assertive than these; hence, the twill is much more prominent on the face than at the back of cloth, where it inclines in the *same* direction as the warp twist.

§ 25. According to the second theory explained in § 23, a twill will be more pronounced if it is produced in a direction whereby the tendency of threads to untwist and roll out of their straight course will be prevented or checked. Therefore, if the

untwisting of threads that will form the ridges of twill causes them to incline to the left, the twill should be produced to the left also, so that the threads will support each other, at the extremities of the float, on those sides towards which they tend to roll. If, however, the threads are left unsupported at those parts, as would occur if the twill were produced in the same direction as the twist, their tendency to untwist and roll would be unchecked, and the floats would assume a slight list in the opposite direction to the twill, as clearly manifested in Fig. 56.

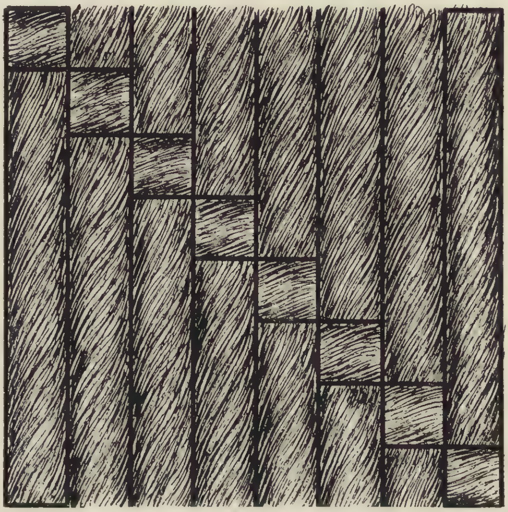


FIG. 59.—Showing the direction of Twill in a Warp-face Twill Fabric with Warp Yarn Spun "Twist-way," to produce a prominent Twill.

§ 26. Whatever may be the influential factor in determining the relative prominence of twills, it may be repeated that those produced in the opposite direction to that of the twist in yarn will be more pronounced than if both are in the same direction; and so long as this dictum is observed, it is immaterial in what direction a twill may incline, or in which direction yarn is twisted during spinning. Therefore, if a bold warp twill is produced from yarn spun "twist" way (Fig. 57), the twill

should incline upward from *right to left*, as represented in Fig. 59. If a weft twill is required from yarn spun "weft" way (Fig. 58) the twill should incline upward from *right to left* also, as in Fig. 60. (This may at first appear inconsistent, until it is observed that the direction or spirality of twist in a spun thread inclines in opposite directions when placed at right angles to itself, as indicated by arrows in Figs. 57 and 58). Again, if a twill weave having warp and weft displayed in equal or nearly equal quantities on both sides of cloth is produced from warp

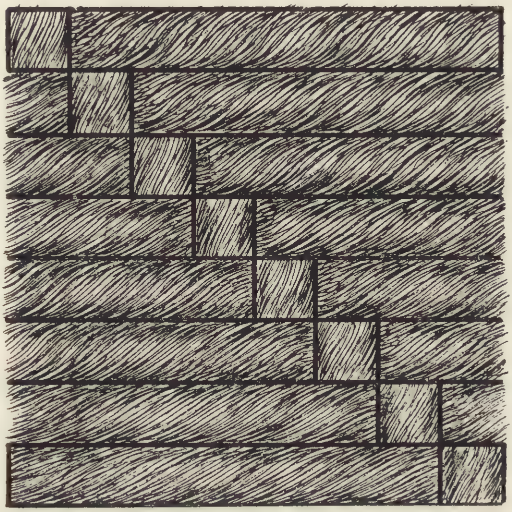


FIG. 60.—Showing the direction of Twill in a Weft-face Twill Fabric with Weft Yarn Spun "Weft-way," to produce a prominent Twill.

spun "twist" way and weft spun "weft" way, the twill should, in this case also, incline upward from *right to left*, as indicated in Fig. 61. If, however, a weft twill is required from yarn spun "twist" way, or a warp twill from yarn spun "weft" way, the twill should incline upward from *left to right*, as in Fig. 62.

2. Zigzag or Wavy Twills.

§ 27. This subdivision of twill weaves comprises those in which the direction of twill is frequently reversed, to produce a

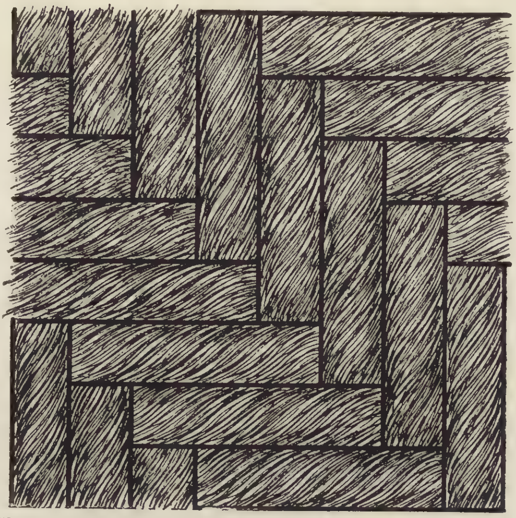


FIG. 61.—Showing the direction of Twill in a Fabric having a Warp and Weft Face, and with Warp Yarn Spun "Twist-way," and Weft Yarn Spun "Weft-way," to produce a prominent Twill.

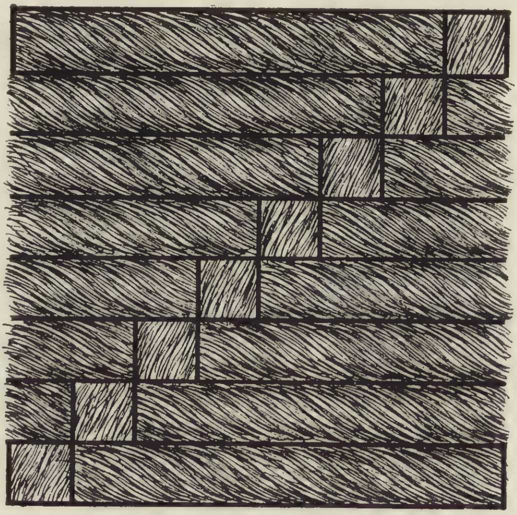


FIG. 62.—Showing the direction of Twill in a Weft-face Twill Fabric with Weft Yarn Spun "Twist-way," to produce a prominent Twill.

series of waves running horizontally, obliquely or vertically, according to the particular manner in which the reversals are made. Any regular twill weave may be employed in the development of wavy twills; also the twill may be reversed at regular or irregular intervals on either warp ends or picks, according to the effect desired. It should be observed, however, that, as a rule, the best effects will be obtained by reversing the twill on that series of threads which will be in greatest abundance on the face of the fabric. Thus, if warp preponderates over weft, the waves should reverse on warp ends; and if weft preponderates over warp, they should reverse on picks of weft,

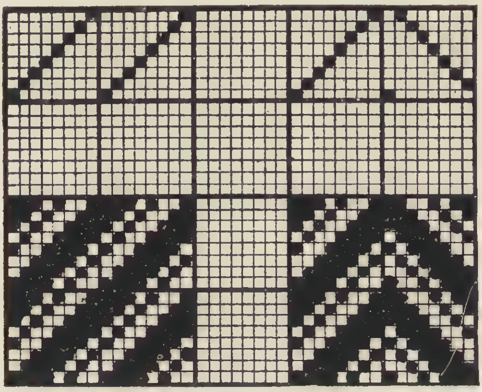


FIG. 63. FIG. 64.

provided of course that the preponderating threads are not inferior in either numbers or quality. By adopting this course, long floats, which would otherwise occur at all points where the twill is reversed, and which look like imperfections in cloth, are avoided, and sharper wave crests and furrows are produced. The accompanying examples of wavy twills are uniformly based on the regular twill weave represented in Fig. 63, which repeats on eight warp ends and picks, and requires eight shafts of healds to weave it, with warp ends drawn through them with a "straight-over" draft, as indicated above the design. This weave has warp preponderating over weft in the ratio of five of warp to three of weft, thus $\frac{4}{1}\frac{1}{2} = \frac{5}{3}$.

Figs. 64, 65 and 66 are horizontal wavy twills produced by reversing weave Fig. 63 at regular intervals of eight, twelve and sixteen warp ends, thereby causing them to repeat on sixteen, twenty-four, and thirty-two warp ends, but only eight picks, respectively. As indicated by the drafts immediately above them, each design requires only eight shafts of healds (as does the original weave) for its production; but they would each require a different set of healds in consequence of the different methods of drafting warp ends through them. If the same weave (Fig. 63) were employed to produce similar wavy effects to those of Figs. 64, 65 and 66, but vertically instead of hori-

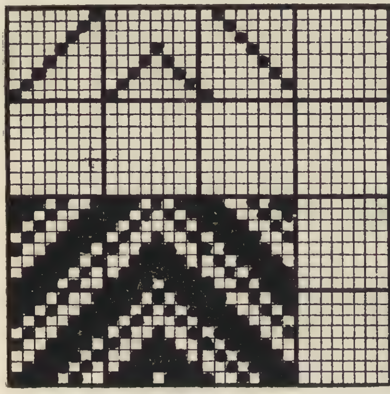


Fig. 65.

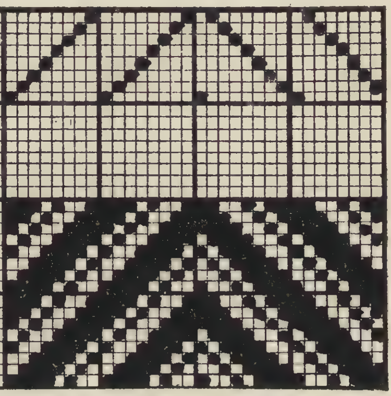


Fig. 66.

zontally, the draft shown above Fig. 63 would answer, and the healds would be raised in consecutive order, forward and backward alternately, for eight, twelve, and sixteen picks, respectively, thereby causing the designs to repeat on twice that number of picks. This latter course would involve the use of dobbies or other shedding devices capable of weaving designs repeating on a large number of picks; whereas, in the former case, the designs could be woven by means of eight-pick tappets.

§ 28. Figs. 67, 68 and 69 are variegated wave effects produced by reversing the twill at irregular intervals of warp ends, so as to produce large and small waves in a horizontal direction. In Fig. 67 the twill is reversed at intervals of four, eight, and four

warp ends continuously. In Fig. 68 the intervals are eight, four, and eight warp ends continuously: and in Fig. 69 they are four, eight, four. eight, and four warp ends continuously.

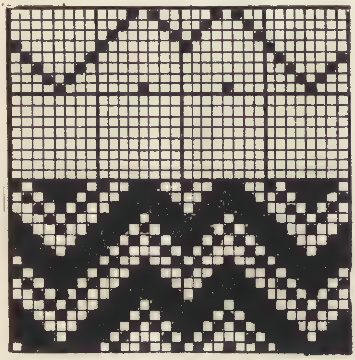


Fig. 67.

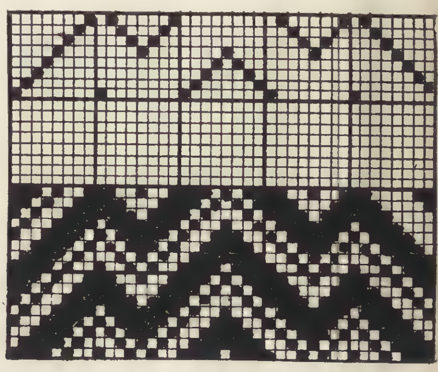


Fig. 68.

By thus reversing for an equal number of warp ends in both directions, the waves assume a horizontal course so far as one or more than one repeat of the pattern is concerned. Only

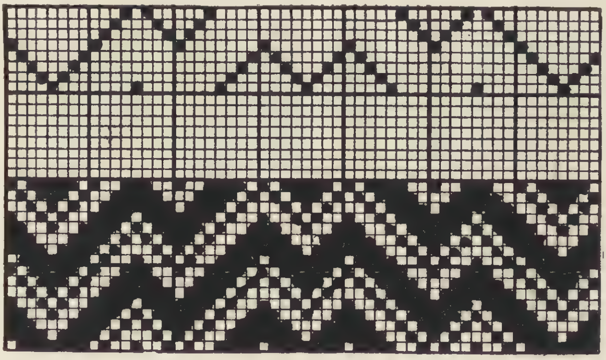


Fig. 69.

eight healds are required to produce these designs; but the drafting of warp ends through them must be as indicated above the respective designs. This causes the patterns to repeat on thirty-two, forty, and fifty-six warp ends, and eight picks, respectively.

§ 29. Figs. 70, 71 and 72 are wavy effects in which the waves are produced obliquely by reversing the twill uniformly at shorter intervals in one direction than in the other. The

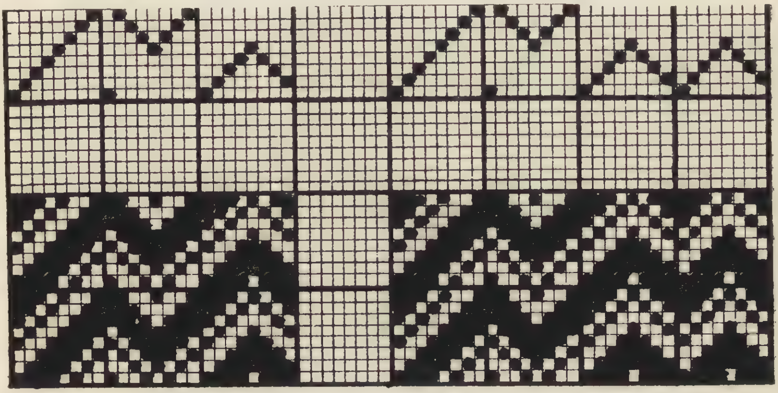


Fig. 70. Fig. 71.

obliquity of the waves may be more or less acute according to the system of reversing, and the intervals at which the reversals

Fig. 72.

occur, as seen in the examples given. In Fig. 70 the intervals are eight and four warp ends alternately, throughout. In Fig. 71, a more acute obliquity is obtained by reversing the twill at

intervals of eight, four, eight, four, and four warp ends continuously; and in Fig. 72 a still more acute slant is produced by reversing the twill at intervals of eight, four, four, and four warp ends continuously. These designs repeat on eight picks, and require eight shafts of healds, with warp ends drafted as shown, to produce them. In the development of wavy twill designs, the relative sizes of waves are determined by the number of threads on which the twill is produced in any direction.

3. Rearranged Twills.

§ 30. Rearranged twills are those evolved by the rearrangement of either warp ends or picks of any regular or continuous twill weave, according to some definite plan. For example, consecutive threads of a given weave may be redistributed at regular intervals of two or more threads apart, as required; or, as an alternative method, threads of a given weave may be taken at intervals of two or more, and arranged consecutively to form a new design.

Satin Weaves.

The simplest application of this system of rearranging twill weaves obtains in the development of what are known as "satin" weaves, produced by rearranging simple continuous warp-face or weft-face twills (as represented in Figs. 31 to 35, and 37 to 41 respectively), according as warp-face or weft-face satin weaves are required. Satin weaves are characterised by an even and smooth surface, of either warp or weft, resulting from a perfectly regular distribution of intersections of those threads. They constitute one of the most useful varieties of weaves and are extensively employed, in conjunction with other weaves, as an element or component part of elaborately decorated fabrics, as well as in the production of piece-good fabrics constructed entirely on the basis of one of such weaves. Although satin weaves are (for convenience of classification) generally regarded as derivations or rearrangements of simple continuous twill weaves, it will be seen that they bear no resemblance whatever to that class, but are entirely different in respect of the distribution of intersections.

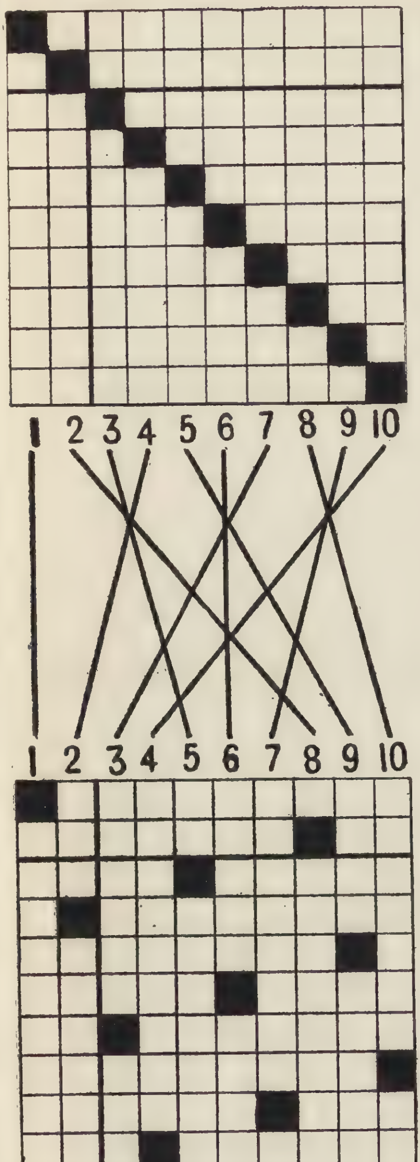


FIG. 73.—Showing the Construction of Satin Weaves.

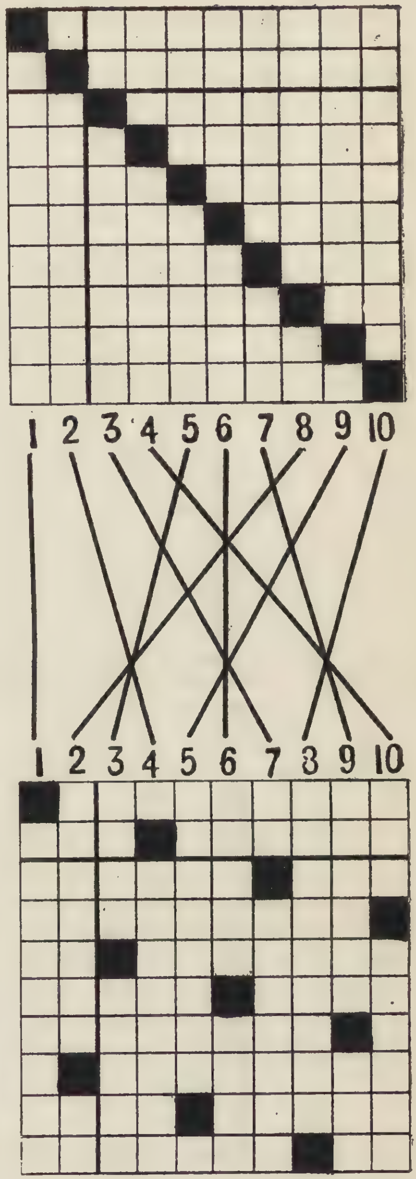


FIG. 74.—Showing an Alternative Method of Constructing Satin Weaves.

§ 31. In the production of satin weaves, the intersections or binding points of warp and weft should be distributed as freely and far apart as possible, on such number of threads as are to constitute one repeat of the pattern. The more perfectly such distribution is accomplished, the more perfect will be the evenness and smoothness of cloth. The rearrangement of any continuous twill weave, to produce either a simple satin weave, or other design having a satin basis, may be made in accordancé with an arithmetical formula to obtain the "*interval of selection*" which determines the positions of intersections or binding points on consecutive threads of either series for any size of satin weave, excepting those contained on four and six threads (which are imperfect satin weaves). Having decided the number of threads on which to construct a satin weave, the "interval of selection" may be either of two complementary numbers whose sum equals the whole number, but which have no common measure.

Example: It is required to construct a ten-end satin weave. The only two complementary divisions of ten, which have no common measure, are three and seven; therefore either three or seven may be taken as the "interval of selection," and the intersections disposed at intervals of three or seven threads of either series, on consecutive threads of the other series.

The application of this formula will be easily understood by reference to Fig. 73, where a ten-end weft-face satin (B) is produced by transposing the threads of a ten-end weft-face twill (A) in the manner indicated; namely, by disposing say every third warp end in A, in consecutive rotation to produce B. Or the same result is virtually attained by the method shown at Fig. 74, where consecutive warp ends in A are redisposed at intervals of three threads to produce B. The only difference between Figs. 73 and 74 is in the reversed sequence of intersections. Again, similar results would obtain by rearranging picks instead of warp ends; and also by adopting the complementary number, seven, as the interval of selection.

Some numbers, as five, eight, ten, and twelve, each permit of only two complementary numbers which have no common measure; whilst some have four, and others more than four,

numbers which have no common measure. As regards those which have four minor numbers, a similar distribution of intersections will occur, whichever of the four is selected as the interval; but as regards those numbers which offer a greater choice of intervals, the selection of the best interval is entirely a matter

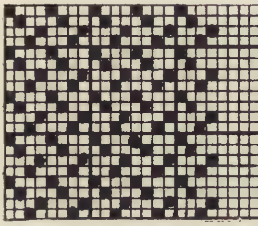


FIG. 75.—4-end.

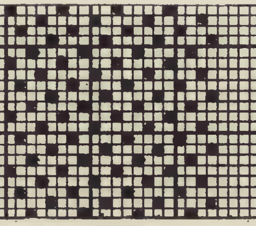


FIG. 76.—5-end.

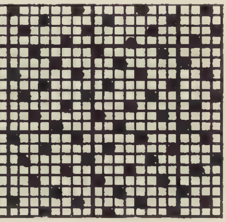


FIG. 77.—6-end.

of judgment and not of rule. In such cases it is better to construct weaves based on each interval, and select that which gives the most perfect and regular distribution of intersections.

§ 32. The following table shows the *intervals of selection* for the construction of satin weaves on five, and seven to twenty-

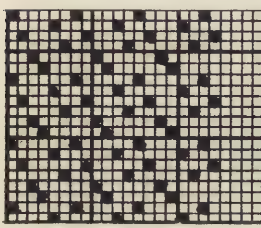


FIG. 78.—6-end.

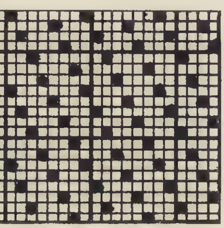


FIG. 79.—7-end.

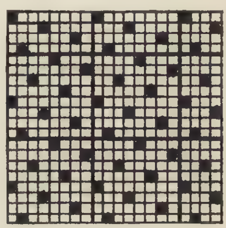


FIG. 80.—8-end.

two threads. Instead of the numbers given, their complements may be taken. Where two intervals are given, each of them or their complements will produce similar results. Where more than two intervals are given, the number or numbers shown in heavy type (or their complements) will give the most perfect distribution of intersections; and those weaves indicated in *italics* are the only satin weaves (included in the following table) in which the distribution of intersections is absolutely perfect :—

Table of Intervals of Selection for the Construction of Satin Weaves.

5-end satin—2.
7-end satin—2, 3.
8-end satin—3.
9-end satin—2, 4.
10-end satin—3.
11-end satin—2, **3, 4,** 5.
12-end satin—5.
13-end satin—2, 3, 4, **5,** 6.
14-end satin—3, 5.
15-end satin—2, **4,** 7.
16-end satin—**3, 5,** 7.
17-end satin—2, 3, **4,** 5, 6, 7, 8.
18-end satin—5, 7.
19-end satin—2, 3, **4, 5,** 6, 7, 8, 9.
20-end satin—**3, 7,** 9.
21-end satin—2, 4, 5, **8,** 10.
22-end satin—3, **5,** 7, **9.**

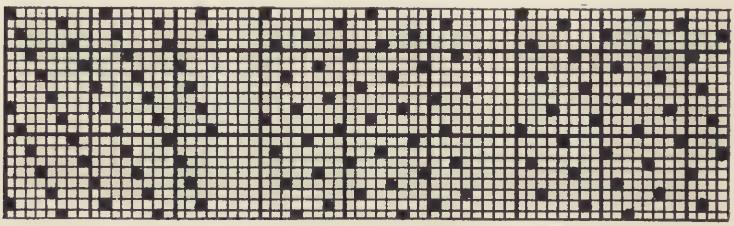


Fig. 81.—9-end. Fig. 82.—10-end. Fig. 83.—11-end.

Figs. 76 and 79 to 94 are weft-satin weaves constructed in accordance with the above table. Fig. 75 is the so-called four-end satin weave; and Figs. 77 and 78 are alternative arrangements of a six-end satin weave. That shown in Fig. 77 is preferable to that shown in Fig. 78, as it gives a more perfect distribution of intersections.

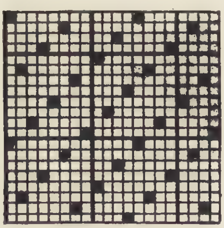


Fig. 84.—12-end.

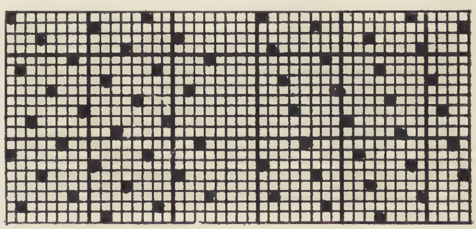


Fig. 85.—13-end. Fig. 86.—14-end.

"Corkscrew" Twills.

§ 33. Corkscrew twills constitute a variety of rearranged twills largely employed in the production of worsted garment fabrics, for which they are eminently suited, as they are capable of producing firm and compact textures of great strength, warmth

and durability. Perfect corkscrew weaves are characterised by a somewhat subdued twill formation, with either warp or weft

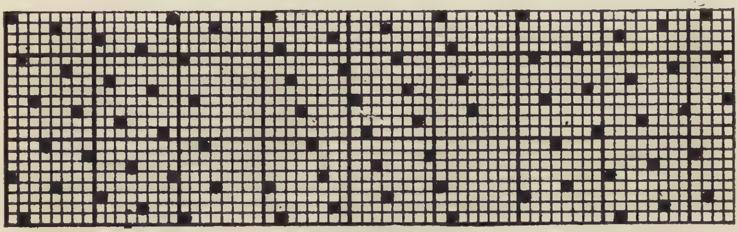


FIG. 87.—15-end. FIG. 88.—16-end. FIG. 89.—17-end.

only visible on the face of the fabric, and are usually constructed on an *odd* number of warp ends and picks. The latter circum-

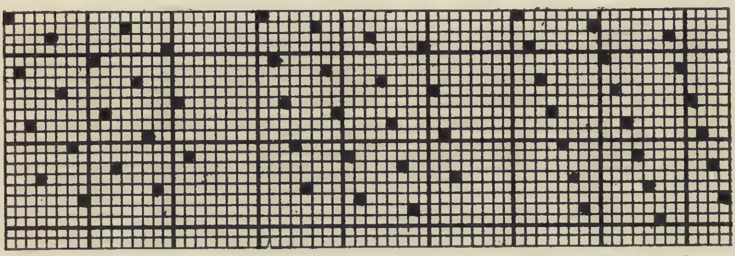


FIG. 90.—18-end. FIG. 91.—19-end. FIG. 92.—20-end.

stance arises from the particular method of constructing them, namely, by rearranging either series of threads of any suitable

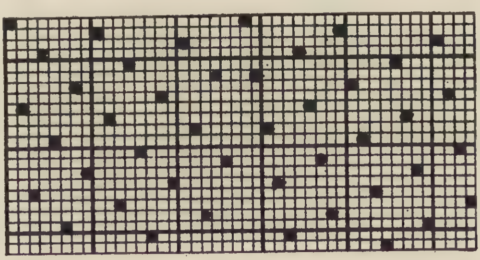


FIG. 93.—21-end. FIG. 94.—22-end.

continuous twill weave at intervals of *two*, or alternately; and since two is not a measure of odd numbers, an *odd* number of

threads are required for one repeat of the pattern, in accordance with the principle governing the construction of satin weaves, as explained in § 31.

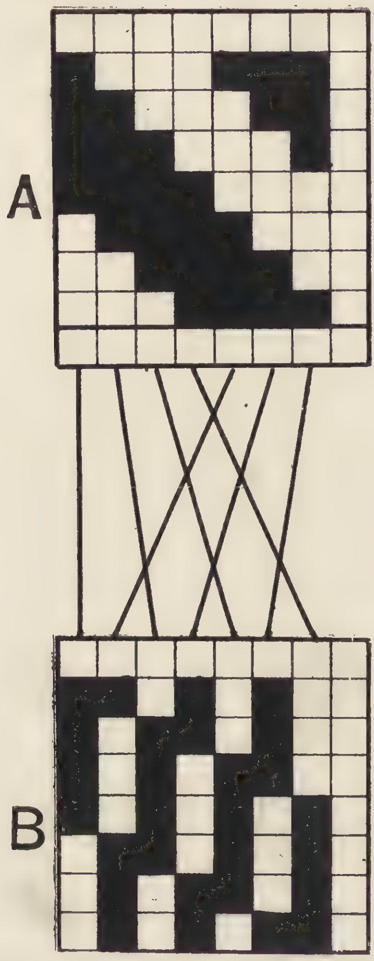


Fig. 95.—Showing the Construction of Warp-face Corkscrew Weaves.

Warp-face corkscrew weaves may be produced by rearranging, in the manner described, the warp ends of any continuous twill that repeats on an *odd* number of threads, and in which warp

floats are *one* thread only longer than weft floats. For weft-face corkscrews, the base pattern must have weft floating *one* thread more than warp; but whichever series of threads are

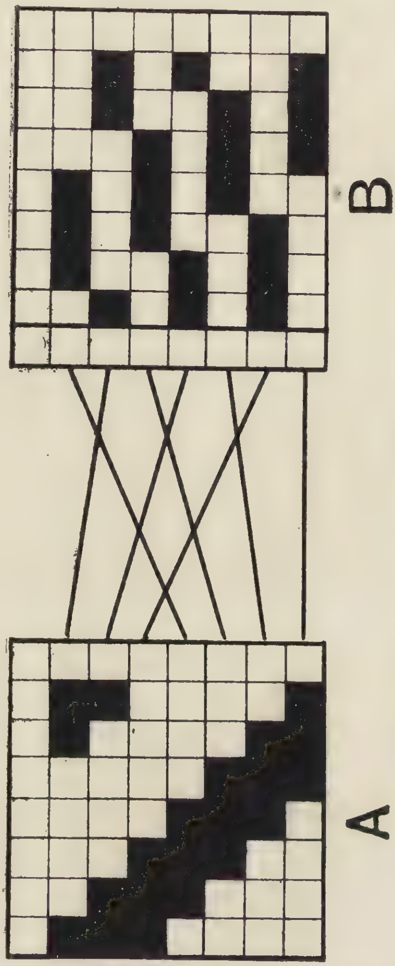


FIG. 96.—Showing the Construction of Weft-face Corkscrew Weaves.

required on the face, they should be of better quality and in greater abundance than the other series.

Fig. 95 shows the method of constructing a warp-face corkscrew weave B, by rearranging warp ends of the seven-end $(\frac{4}{3})$

continuous twill weave A, in the manner indicated. It will be seen that B is produced by rearranging consecutive warp ends

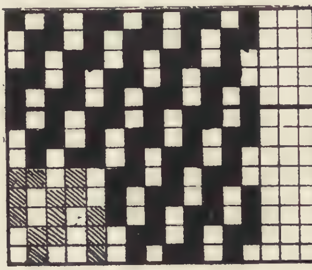
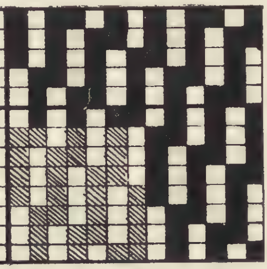



FIG. 97. FIG. 98.

in A at intervals of two threads, or alternately, on the same

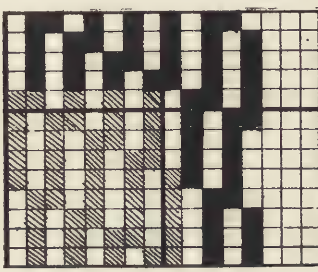
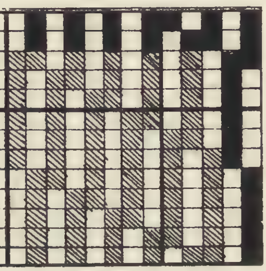



FIG. 99. FIG. 100.

number of warp ends. In like manner, a weft-face corkscrew B

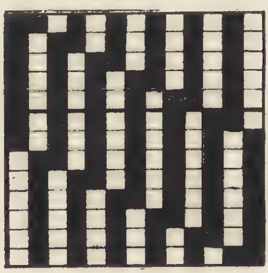


FIG. 101.

(Fig. 96) is produced by rearranging picks of the seven-end $\left(\frac{3}{4}\right)$ continuous twill A. Figs. 97 to 101 are examples of perfect warp-face corkscrew weaves, and Figs. 102 to 106, of weft-face

corkscrew weaves, repeating on five, seven, nine, eleven, and thirteen threads respectively. Judging from these weaves as indicated on design paper, in which the threads are represented as if spread out and lying parallel side by side without compression, it would appear that *weft* would be visible on the face of the fabric in warp-face corkscrews, and *warp* in weft-face

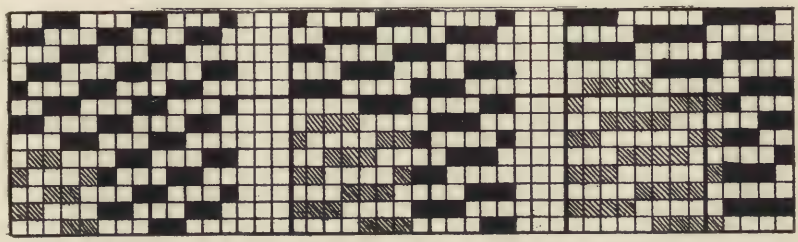


Fig. 102. Fig. 103. Fig. 104.

corkscrews. This would actually occur if the floating threads were not in considerably greater numbers and therefore more densely crowded than the other series of threads. But by increasing the numerical density of floating threads, over covered threads, the latter will be quite obscured by the former closing over and entirely covering them.

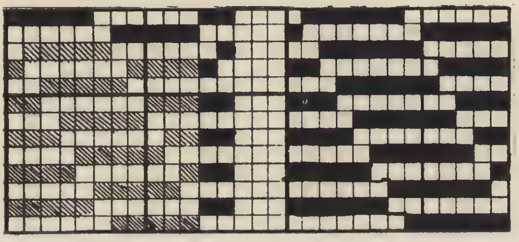


Fig. 105. Fig. 106.

§ 34. Corkscrew weaves may be modified to a considerable extent without departing from the general principle governing their construction. They may also be made to assume variegated and other decorative effects, as horizontal and oblique waves, and many others ; but the necessity of having one series of threads greatly in excess of the other series prevents the

successful employment, in bulk, of the sparse threads. Simple corkscrews may also be constructed on an *even* number of threads; but these will lack the perfect uniformity of surface possessed by those constructed on an *odd* number of threads; yet, on the other hand, it opens out unlimited scope to a designer in the production of new and varied effects. It should be pointed out, however, that odd-thread warp-face corkscrews repeat on

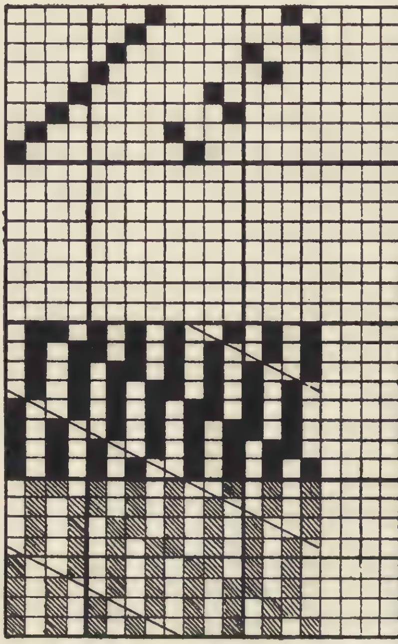


FIG. 107.—Even-thread Corkscrew Weave.

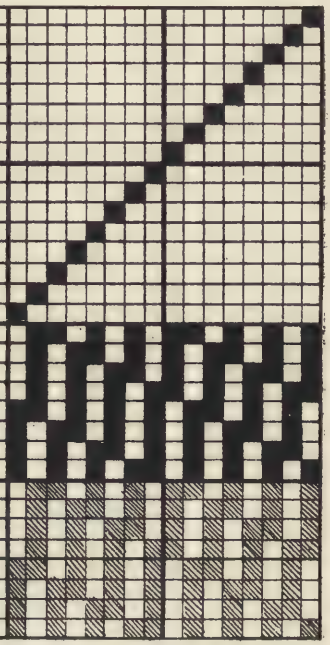


FIG. 108.—Even-thread Corkscrew Weave.

the same number of threads as their base weaves, and require only that number of healds to weave them; whereas even-thread warp-face corkscrews occupy twice as many threads as their base weaves, and sometimes require twice that number of healds to weave them.

Fig. 107 is an example of an even-thread corkscrew weave, based on an eight-end four-and-four twill, and requiring sixteen warp ends and eight picks to complete the pattern. It is but

slightly removed from a perfect corkscrew weave, and virtually consists of a double diagonal warp rib, separated by a single diagonal cutting of weft which emphasises the twill formation in cloth. Fig. 108 is another example of a corkscrew weave on eight threads, but without a definite twill formation. It is produced by causing alternate warp ends to float over one pick more than the others, thereby preventing weft from passing over more than one warp end, as in perfect corkscrews. This unequal floating of warp ends will, of course, produce diagonal ribs of different widths; but that feature will be scarcely, if at all, discernible in the larger weaves, excepting where the variation in the length of float is considerable. It is worthy of note, also, from an economical point of view, that the slight departure in the construction of Fig. 108 involves the use of sixteen shafts of healds, with a straight-over draft, whereas Fig. 107 could be woven with only eight shafts of healds, with a broken draft, as indicated above the respective designs.

§ 35. It was explained in § 31 that satin weaves were evolved by rearranging threads of warp-face or weft-face continuous twill weaves in a prescribed manner. That system of rearrangement is equally applicable to other forms of continuous twills, and is one that offers considerable scope to a designer in the production of fancy weaves of great utility. Whatever form of twill weave may be selected, its rearrangement on a satin basis is governed by the same principle as that which operates in the construction of simple satin weaves. The weave to be rearranged must, of course, repeat on the same number of threads as that of the satin weave which forms the basis of rearrangement; otherwise the new design could not be completed on that number. The rearrangement may also be made in respect of either warp ends or picks of weft, with oftentimes very different results, as will be seen in some of the following examples. The best course to adopt, in the rearrangement of twills, on a satin basis, is to indicate on design paper the particular satin weave required to form the basis of rearrangement, and then proceed to rearrange either warp ends or picks of the base twill weave, according to the disposition of the binding points indicated, which serve as starting-points. In the follow-

ing examples, illustrating the development of designs by this method, shaded squares in the base weaves indicate the *twill* basis ; whilst in the re-formed designs, shaded squares indicate the *satin* basis on which they are rearranged.

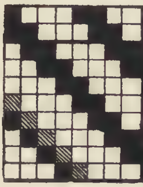


FIG. 109.

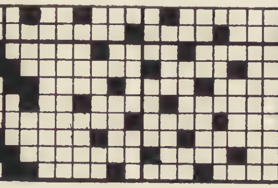


FIG. 110.

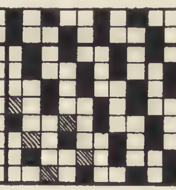


FIG. 111.

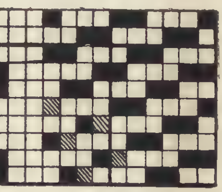


FIG. 112.

Fig. 109 is a twill weave contained on five threads, and constitutes the base weaves for designs Figs. 111 and 112. Fig. 111 is produced by rearranging *warp ends* of Fig. 109 on a five-end satin basis, as indicated in Fig. 110. Fig. 112 is another weave produced by rearranging, in the same order, *picks of weft* of the same base weave. Figs. 115 and 116 are rearrangements of warp and weft threads respectively of a six-end twill

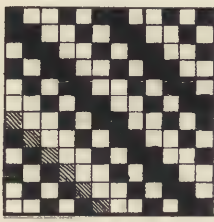


FIG. 113.

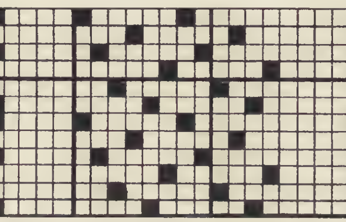


FIG. 114.

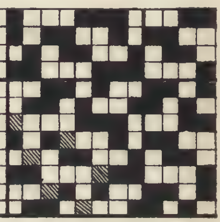


FIG. 115.

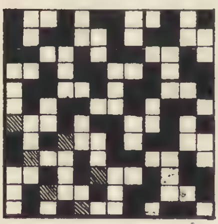


FIG. 116.

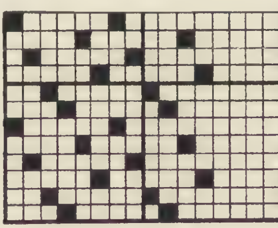


FIG. 117.

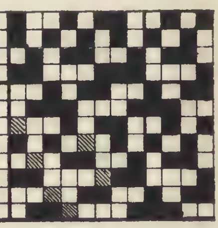


FIG. 118.

(Fig. 113) on the six-end satin basis indicated in Fig. 114; whilst Figs. 118 and 119 are rearrangements of warp and weft threads respectively of the same base weave (Fig. 113), but on the six-end satin basis indicated in Fig. 117.

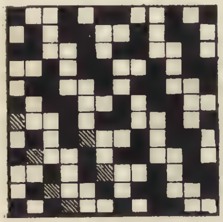


Fig. 119.

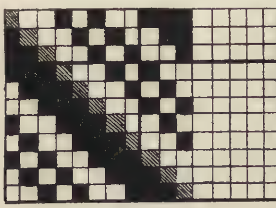


Fig. 120.

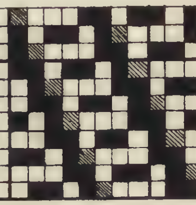


Fig. 121.

When a base weave is contained on such number of threads as will permit of two or more intervals of selection that are not

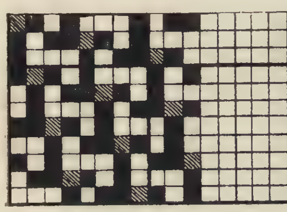


Fig. 122.

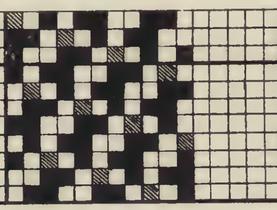


Fig. 123.

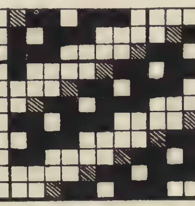


Fig. 124.

complementary to each other, a proportionately greater diversity of new weaves may be produced from it by rearranging its

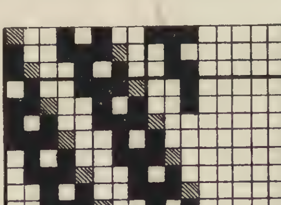


Fig. 125.

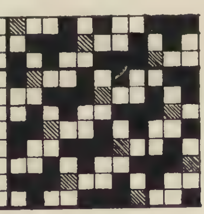


Fig. 126.

threads on the respective intervals which that number gives. For example, a base twill weave (Fig. 120) repeating on eleven threads, may be rearranged so as to produce eight different

weaves constructed on a satin basis, because eleven is a number which gives eight intervals of selection, namely, two, three, four, and five, and their complements. Therefore, by rearranging both warp and weft threads on each interval, eight new designs may be made. Figs. 121 to 124 are produced by rearranging warp ends, and Figs. 125 to 128 are produced by rearranging

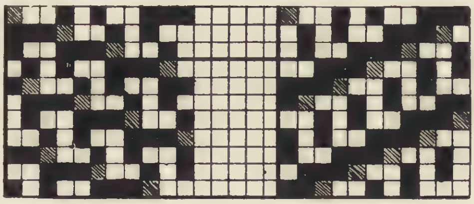


FIG. 127. FIG. 128.

picks of weft, at intervals of two, three, four, and five threads, respectively.

§ 36. Another method of rearranging either warp or weft threads of a base pattern, to create new designs, is by adopting a uniform interval of two threads irrespective of the number of threads on which the original weave is contained. This system,

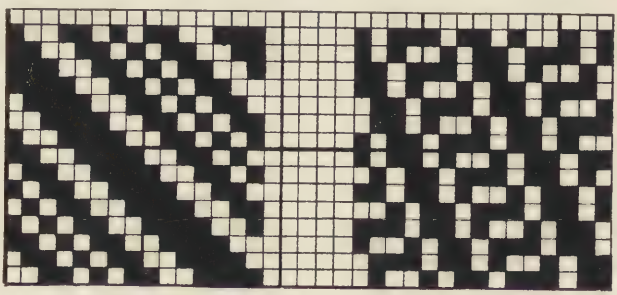


FIG. 129. FIG. 130.

however, offers considerably less scope to a designer than the foregoing, and should only be employed for the production of weaves in which a decided twill formation will not be displeasing. By this system, a twill formation will almost inevitably result in all cases, in consequence of laying alternate threads of a base weave in consecutive rotation, or *vice versâ*. If warp ends

are rearranged, the twill will approach the vertical, and if weft threads are rearranged, the twill will approach the horizontal.

It should be observed that by this system, rearranged weaves based on odd-thread weaves will repeat on the same number of warp ends and picks as that of their base weaves; whilst those based on even-thread weaves will repeat on only one half the number of threads in one direction, as that of their base weaves. This is explained by the fact that *two* (the interval used) is a measure of *even* numbers, but not of *odd* numbers. Therefore, designs repeating on an odd number of threads require them all to be employed in order to complete the new design; whilst only one half are necessary in respect of even-thread designs.

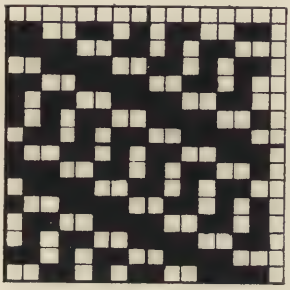


FIG. 131.

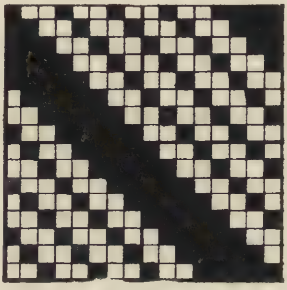


FIG. 132.

Figs. 129 to 134 will serve to demonstrate the application of this principle of rearrangement in the creation of new designs. Fig. 129, a twill weave contained on fifteen warp ends and picks, is selected as the base weave. By placing alternate warp ends of the base weave in consecutive rotation until the pattern is complete, a new design repeating on fifteen warp ends and picks, as indicated in Fig. 130, is obtained. In like manner, if alternate picks of weft of the base weave are placed in consecutive rotation, the weave indicated in Fig. 131 is obtained. The only difference between the two new designs is in respect of the angle of twill, as just explained.

Figs. 133 and 134 are produced by rearranging, in a similar manner, warp ends and picks of weft, respectively, of a base weave (Fig. 132) contained on an *even* number of threads,

namely, sixteen. Since only one half the number of warp ends in the base weave are required to produce Fig. 133, the latter is complete on eight warp ends and sixteen picks. Also, for a similar reason, but in respect of picks, Fig. 134 is complete on sixteen warp ends and eight picks, as indicated in both cases by shaded squares.

4. Combined Twills.

§ 37. Combined twills are those produced by arranging the threads of two continuous twill weaves alternately with each other. Either warp ends or picks of weft of the two base weaves may be alternated. If warp ends are combined, the angle of twill in the resultant weave will be less than forty-five degrees ;

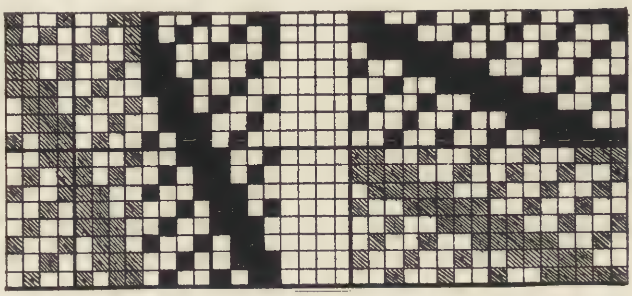


Fig. 133. Fig. 134.

but if picks are combined the angle of twill will be greater than forty-five degrees, to picks of weft. If it is desired to produce a low-angle twill by this method, the best results will be achieved by selecting two base weaves in which weft preponderates over warp. For high-angle twills, the base weaves should have warp preponderating over weft.

By this system of combination, there is practically no limitation to the production of new weaves of great variety and interest, and of great value to the textile designer. It obtains almost exclusively in the worsted industry in the production of garment fabrics, as it is capable of producing compact and firm textures.

Any two weaves may be combined in the manner described, irrespective of their relative sizes. The size of the resultant

weave, however, depends upon the number of threads occupied by the respective base weaves employed. Thus, if two base weaves, each occupying the same number of threads, are com-

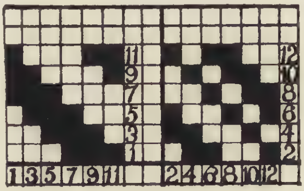


Fig. 135. Fig. 136.

bined end and end (*i.e.*, a warp end from one weave, and a warp end from the other alternately), one repeat of the combined

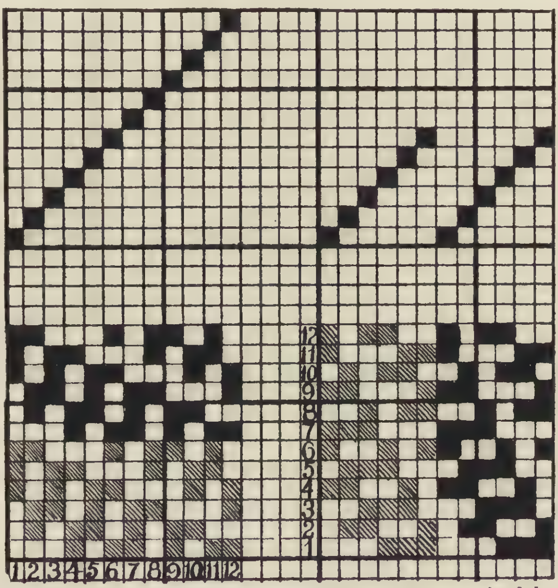


Fig. 137.—Design evolved by End-and-end combination of Figs. 135 and 136.

Fig. 138.—Design evolved by Pick-and-pick combination of Figs. 135 and 136.

twill weave will occupy twice as many warp ends, and the same number of picks, as those of the respective base weaves. If, on the other hand, the base weaves are combined pick and pick, the

combined twill would occupy twice as many picks, and the same number of warp ends, as either of the base weaves. For example, Figs. 135 and 136 are two continuous twill weaves, each repeating on six warp ends and picks. By combining them end and end a new design is produced, repeating on $6 \times 2 = 12$ warp ends and six picks, as shown in Fig. 137. If picks instead of warp ends of the same base weaves are alternated, a new weave is produced, repeating on six warp ends, and $6 \times 2 = 12$ picks, as shown in Fig. 138.

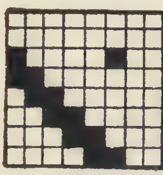


FIG. 139.

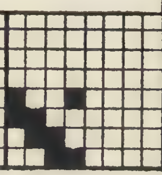


FIG. 140.

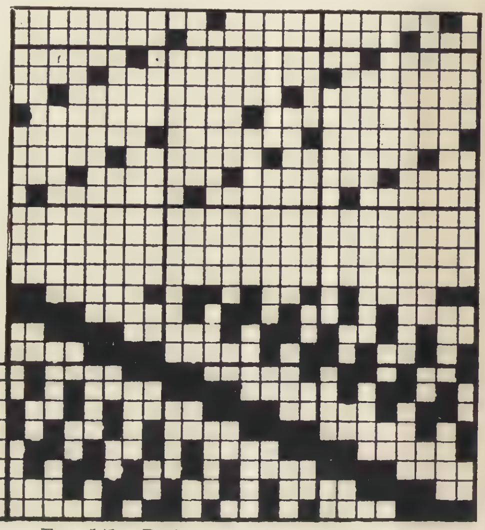


FIG. 141.—Design evolved by End-and-end combination of Figs. 139 and 140.

If two weaves, each repeating on a different number of threads, are combined end and end, the resultant weave will repeat on such number of warp ends as equals the least common multiple of those numbers, multiplied by 2; and on such number of picks as equals the least common multiple only of those numbers. This rule also applies in a corresponding manner if picks of weft are combined. *Example:* two weaves, Figs. 139 and 140, repeat on four and six warp ends and picks respectively. If combined end and end, the resultant weave,

Fig. 141, will repeat on twenty-four warp ends and twelve picks, because twelve is the least common multiple of the numbers four and six. By combining the same base weaves pick and pick, a design is produced, repeating on twelve warp ends and twenty-four picks, as shown in Fig. 142. If two weaves repeat-

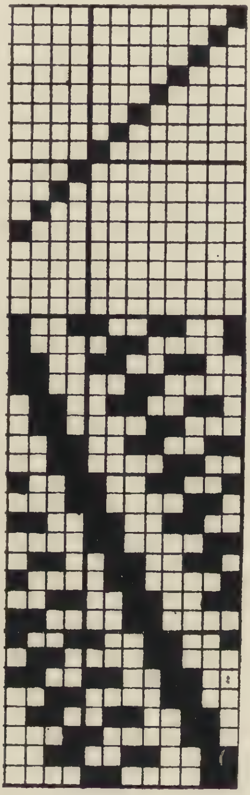


FIG. 142.—Design evolved by Pick-and-pick combination of Figs. 139 and 140.

ing on eight and five threads respectively are combined, the resultant weave will occupy forty threads in one direction, and eighty in the other direction, according to which series of threads are combined. This is exemplified by Fig. 145, which is produced by combining end and end the base weaves, Figs. 143 and 144, repeating on eight and five threads respectively.

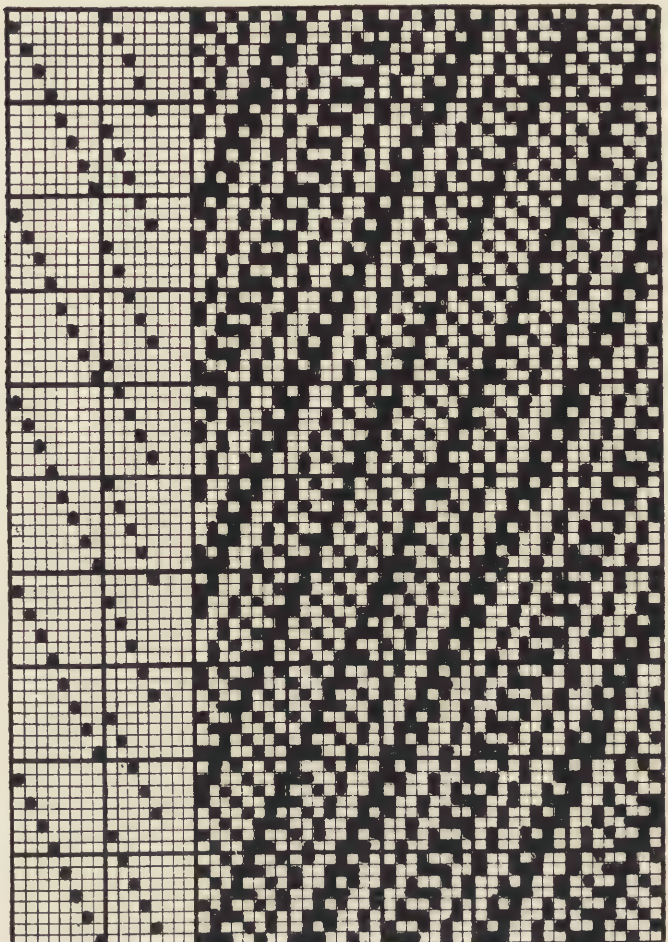


FIG. 145.—Design evolved by End-and-end combination of Figs. 143 and 144.

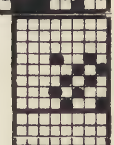


FIG. 144.

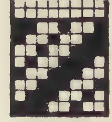


FIG. 143.

It should be observed that although a combined twill weave obtained by alternating warp ends of two base weaves may occupy many times more warp ends than either of its base weaves, it will only require, for its production, such number of healds as equals the sum of those required to weave the respective base weaves; whereas, if picks of weft of two base weaves are alternated to produce a combined twill weave, the number of healds required to weave it corresponds with the number of warp ends occupied by the resultant weave. This is indicated by the drafts placed above the respective designs. It will be

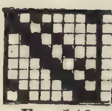
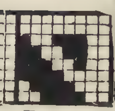
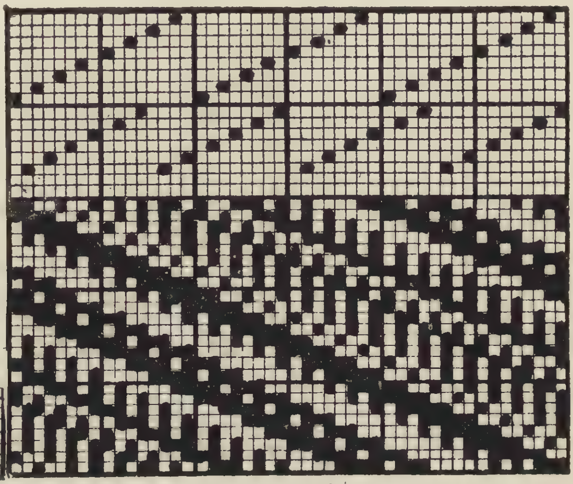




FIG. 146. FIG. 147. FIG. 148.—Design evolved by End-and-end combination of Figs. 146 and 147.

seen that a design produced by combining picks may be woven with a "straight," *i.e.*, continuous, drafting; whereas, one produced by combining warp ends will require what may be termed a "compound" draft, *i.e.*, in which the healds are virtually in two sets—one set governing alternate warp ends in accordance with one base weave, and the other set governing the remaining warp ends in accordance with the other base weave, and with each division of threads drawn "straight through" on their respective sets of healds, as shown.

By this system of combining twill weaves, additional scope is

sometimes offered a designer in the production of varied effects, even from the same base weaves, by the simple expedient of placing the latter in different relative positions; that is, by placing the threads of one weave one thread, or more than one thread, in advance or in rear of those of the other weave. This is exemplified by Figs. 146 to 151. Figs. 146 and 147 are two base weaves, repeating on eight and six threads respectively, and combined end and end to produce design, Fig. 148. By combining the same base weaves, but in the relative positions shown in Figs. 149 and 150, a new design, Fig. 151, is produced.

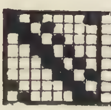


FIG. 149.

FIG. 150.

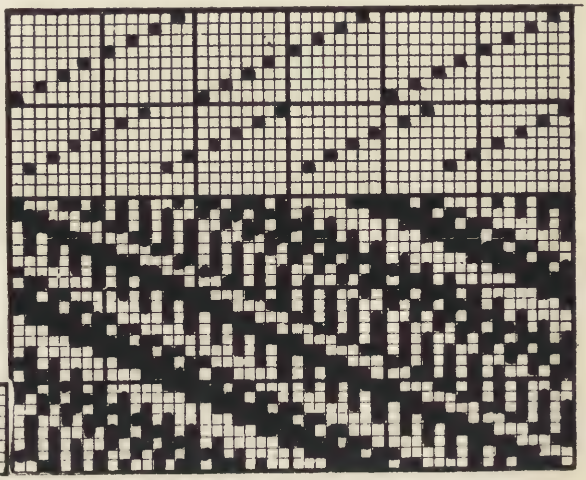


FIG. 151.—Design evolved by End-and-end combination of Figs 149 and 150.

5. Broken Twills.

§ 38. Broken twills comprise that class of weaves produced by breaking the continuity of any continuous twill weave at either regular or irregular intervals of threads. Such a course somewhat tends to the formation of stripes, either in the direction of warp or of weft, according as the twill is broken lengthwise or crosswise respectively. If the twill is broken at regular intervals of threads the stripes will be of uniform width; but if broken at irregular intervals the stripes will be variegated.

In either case the stripes will be more or less pronounced according to the character of twill employed, and the manner in which it is broken. The twill may incline in one direction throughout, or it may be reversed in alternate stripes, or in any other manner, to emphasise the striped effect. The stripe formation may also be emphasised by the principle of counterchange,

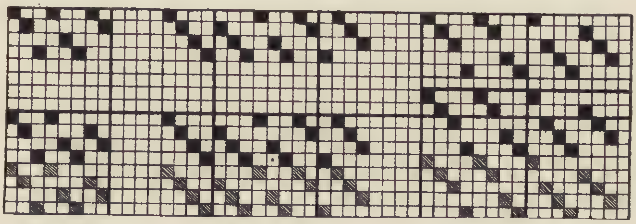


FIG. 152. FIG. 153. FIG. 154.

effected by reversing the weave after each break, as in Figs. 155 to 162, and 165 and 166. The reversal of weave may also be made in conjunction with a reversal of the direction of twill (to obtain a still more pronounced stripe formation) as exemplified in Figs. 170 to 176.

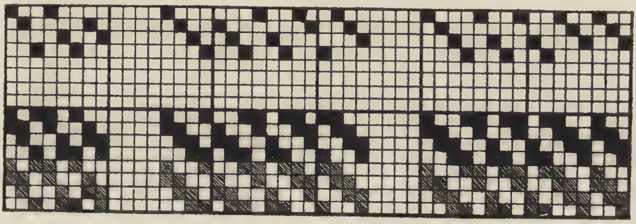


FIG. 155. FIG. 156. FIG. 157.

Fig. 152 is one of the simplest examples of a broken twill weave in which the twill inclines in the same direction throughout. It is based on the four-end weft-face twill, broken at intervals of two warp ends, and advanced one pick at a time after each break. The pattern is complete on eight warp ends and four picks, and may be woven with only four healds, drafted in the manner indicated above the design. In the following examples, shaded squares indicate one repeat of the pattern, and the drafts are indicated above their respective designs.

Figs. 153 to 166 are other examples of broken twill weaves, based upon (*a*) simple, (*b*) even-sided, and (*c*) uneven-sided twills, in all of which the twill inclines in the same direction throughout. Fig. 153 is also based on the four-end weft-face

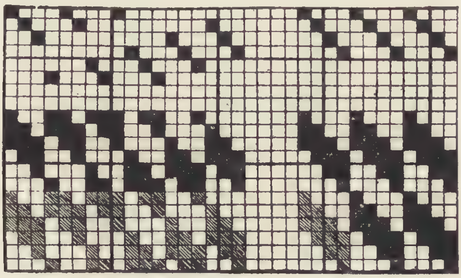


Fig. 158. Fig. 159.

twill, broken at intervals of four warp ends, and advanced one pick after each break; whilst Fig. 154 is produced by breaking a five-end weft-face twill at intervals of three warp ends, with a very different result.

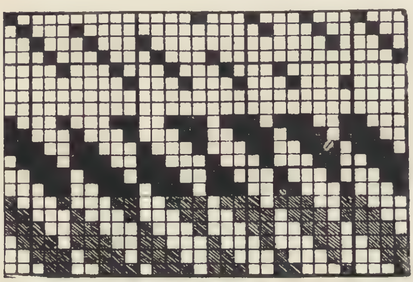


Fig. 160.

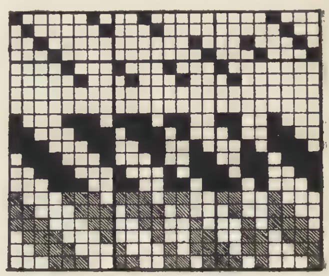


Fig. 161.

Figs. 155 and 156 are produced by breaking a four-end two-and-two twill at intervals of two and four warp ends respectively; whilst Fig. 157 is based on the same weave broken at irregular intervals of five and three warp ends alternately.

Figs. 158 to 160 are all based on a six-end three-and-three twill, broken at intervals of three, four, and five warp ends,

respectively. Fig. 161 is based on the same weave, broken at irregular intervals of eight, four, two, four, two, and four warp ends.

Fig. 162 is also based on an even-sided twill, but of different construction to that employed for the last four designs. The

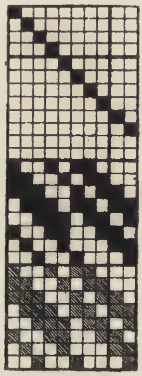


Fig. 162.

base weave is an eight-end $\frac{3}{2}\frac{1}{2}$ twill, broken at intervals of five threads, with the weave entirely reversed, but with the twill continued in the same direction. By reason of the foregoing

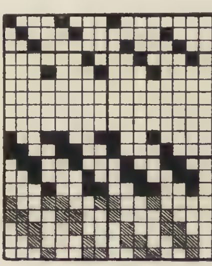


Fig. 163.

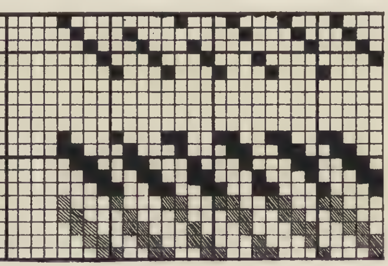


Fig. 164.

even-sided twills being broken in the manner indicated, they are counterchanged in respect of the weave only, and not in respect of the direction of twill, which remains the same throughout.

Figs. 163 and 164 are based on the uneven-sided five-end two-and-three twill, broken at intervals of three and five threads respectively; whilst Fig. 165 is based on the same weave,

broken and counterchanged at irregular intervals of ten, two, four, and two warp ends.

Fig. 166 is based on the six-end four-and-two twill, broken and counterchanged at intervals of eight, four, two, four, two, and four warp ends.

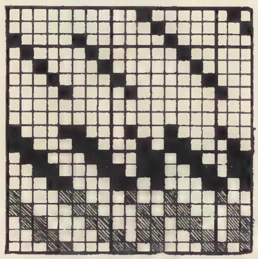


FIG. 165.

Although the foregoing examples illustrate the development of broken twill weaves having the twill in one direction only, they serve equally well to demonstrate the formation of those in which the twill is reversed, *i.e.*, produced to the right and left

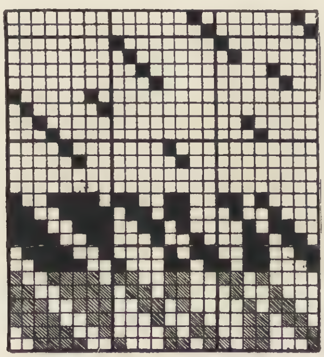


FIG. 166.

alternately, or otherwise. The simplest example of this variety is that shown in Fig. 167, based on the simple four-end weft twill, and well known as the four-end satin or satinette weave. It is produced by breaking and reversing either warp ends or picks at intervals of two threads. Figs. 168 and 169, known

as "rice" weaves, are produced in a similar manner by breaking and reversing simple six-end and eight-end weft twills at intervals of three and four threads respectively.

The next and last variety of weaves to be described under this division comprises those in which the twill is broken and

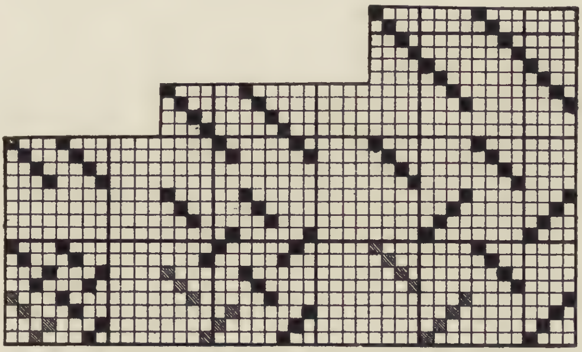


FIG. 167. FIG. 168. FIG. 169.

reversed in counterchange—a plan largely adopted by designers in the construction of garment and other fabrics requiring good wearing properties, and capable of resisting tensile strain in all directions.

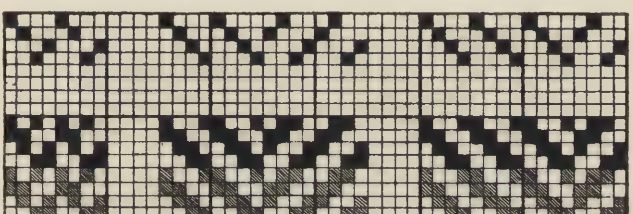


FIG. 170. FIG. 171. FIG. 172.

One of the simplest examples of this variety is that shown in Fig. 170, produced by breaking and reversing, in counterchange, the four-end two-and-two (also known as the "Harvard") twill, at intervals of two warp ends. This weave is extensively employed in all classes of fabrics, as it produces a comparatively firm and compact texture. As a neutral ground filling of a subdued character, for light or medium brocade

fabrics figured by a Jacquard machine, it cannot be excelled. If the twill of this or similar twill weaves is continued for a number of threads and then reversed, as in Fig. 171, it produces the well-known "herring-bone" effect, repeating, in this case, on

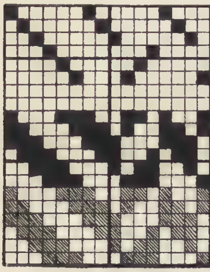


FIG. 173.

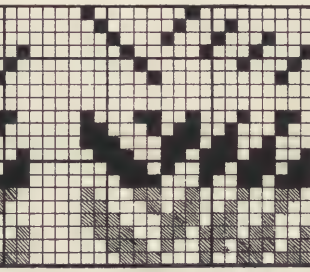


FIG. 174.

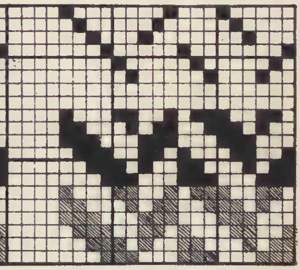


FIG. 175.

sixteen warp ends and four picks. Other examples of this class of weaves are given in Figs. 172 to 176, which are sufficient to indicate the general lines on which they are constructed, and

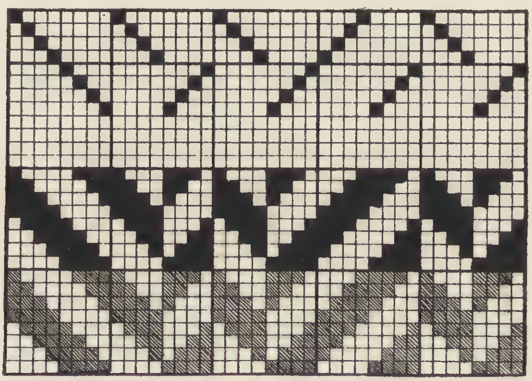


FIG. 176.

the immense scope which this plan offers in the development of new weaves of great variety and utility.

6. Figured or Ornamented Twills.

§ 39. This division of twills comprises that variety of weaves produced by combining simple figuring, with a twill weave, as

a means of embellishment. The amount of embellishment may vary from the least departure from a normal twill, to a degree when there is little to identify it as a twill weave, beyond its diagonal formation. It must not be assumed from this that all patterns having a diagonal formation may be classed as figured twills; but only such as conform, in some measure, to the general principles governing the construction of twill weaves.

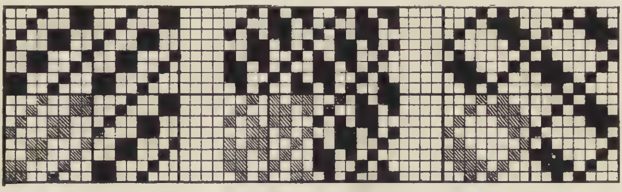


Fig. 177. Fig. 178. Fig. 179.

The term "figured twills" is here used to signify only such weaves of that class as may be produced by the aid of tappets and dobbies. The present examples will, therefore, be confined to such as will require not more than twenty healds to weave them. Notwithstanding this limitation, the construction of figured twills virtually affords illimitable scope to a designer,

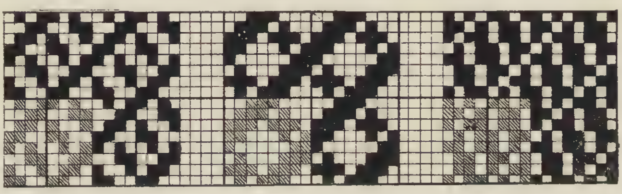


Fig. 180. Fig. 181. Fig. 182.

since he is no longer restricted to twilled effects pure and simple, but may call to his aid all the elements of fabric structure.

The additional scope which this class of designs offers to a designer demands both greater technical and artistic ability than is required for the simpler varieties of twill weaves. In the latter, the perfect regularity of weave causes uniform tension upon all warp ends, thereby producing a general evenness of texture throughout; whereas, in the former class, care must be taken to ensure sufficient and uniform interlacement of threads;

otherwise some portions of the fabric will be flimsy and weak, and some threads will be subjected to greater strain than others, thereby causing a crimped or wrinkled appearance in cloth. These precautions must be taken when producing designs for any class of fabric whose warp ends, during weaving, are delivered from one warp beam only.

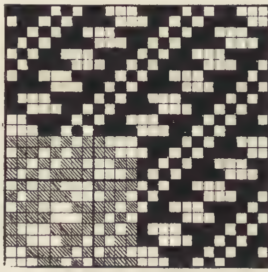


Fig. 183.

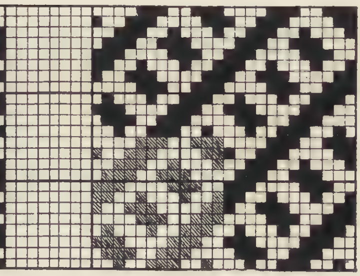


Fig. 184.

The present examples are illustrative of figured twill weaves, repeating on eight, twelve, sixteen, and twenty warp ends and picks. Little can be said regarding their construction, as they are not conformable to any definite rules, but depend wholly upon the imagination and technical ability of the designer. It

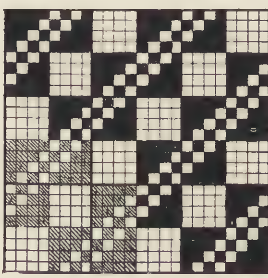


Fig. 185.

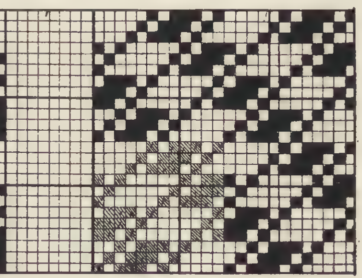


Fig. 186.

should be observed, however, that whatever is introduced or combined with a twill weave, as a recurring element, it must recur on such number of threads (counting diagonally) as constitutes a measure of the total number of threads on which the pattern is required to repeat, otherwise the continuity of the pattern will be broken. For example, if a pattern is required to repeat

on twenty warp ends and picks, figuring elements may recur at intervals of two, four, five, or ten threads diagonally. This will be better understood by reference to the accompanying designs.

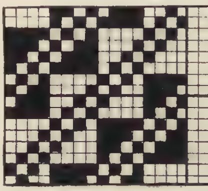


FIG. 187.

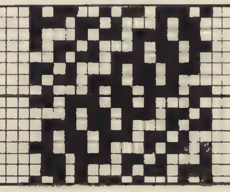


FIG. 188.

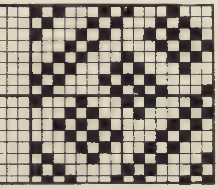


FIG. 189.

Figs. 177 to 182 are various forms of twill weaves, repeating on eight warp ends and picks, to which are added simple figuring devices, disposed at intervals of two threads diagonally, in Figs.

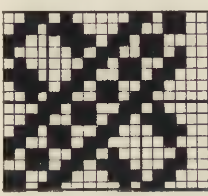


FIG. 190.

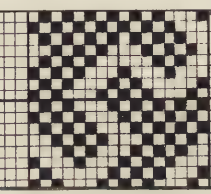


FIG. 191.

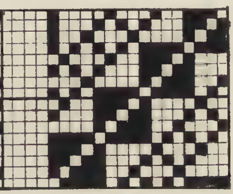


FIG. 192.

177, 178, 180 and 182; whilst in Figs. 179 and 181 the devices are four threads apart, counting from and to corresponding points.

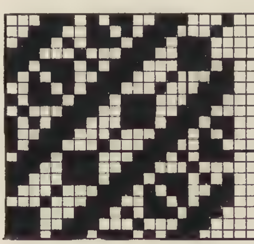


FIG. 193.

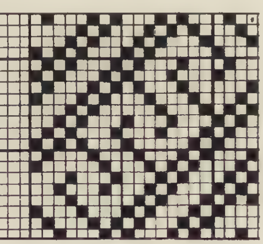


FIG. 194.

Figs. 183 to 186 are designs repeating on twelve warp ends and picks, with the figuring devices recurring at intervals of two, three, four, and six threads respectively.

Figs. 187 to 192 are designs repeating on sixteen threads each way. In Fig. 188 the figuring units recur at intervals of two threads ; in Figs. 187 and 189, at intervals of four ; in Fig. 191,

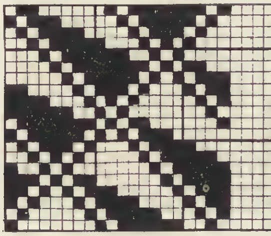


Fig. 195.

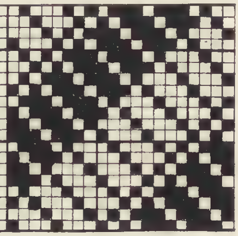


Fig. 196.

at intervals of eight ; whilst in Figs. 190 and 192, some devices recur at intervals of two, and others at intervals of four threads.

Figs. 193 to 197 are designs repeating on twenty threads each way, with the figuring devices recurring at intervals of

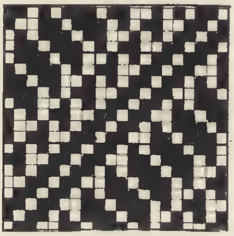


Fig. 197.

five threads in Figs. 193, 194 and 195, and at intervals of two threads in Figs. 196 and 197.

Although examples of figured twills could be multiplied *ad libitum*, the foregoing are sufficient to indicate the immense scope they offer for the production of varied effects suitable for all classes of fabrics.

CHAPTER IV.

DIAMOND AND KINDRED WEAVES.

§ 40. Diamond weaves comprise all such weaves as are characterised by a diamond or a lozenge general formation. They may be produced in infinite variety, and constitute one of the most valuable classes of weaves for almost any type of fabric. They may be constructed with either warp or weft preponderating on the face of the fabric, or with each developed in equal quantities as required, and may be made to yield either a comparatively smooth or else a very rough and open texture, as exemplified in honeycomb and similar weaves. Their diamond or lozenge formation may be more or less pronounced, or even entirely obscured, as in honeycomb and similar weaves, which are characterised by a more or less distinct rectangular cellular formation.

The simplest example of a diamond weave is that contained on four warp ends and picks, as shown in Fig. 198, formed by producing a four-end weft twill to both the right and left. Larger weft diamond weaves of a simple character are formed by crossing larger twill weaves in a similar manner; thus Figs. 199 and 200 are produced from six-end and eight-end weft twill weaves respectively.

Although diamond weaves may be made on any number of threads, those contained on an even number may be produced with sharper definition than those based on an odd number, providing the opposing twills cross on a single warp end and pick, as in Figs. 198 to 200, and not on two contiguous threads, as in Figs. 201 to 203, which are contained on five, seven, and nine threads respectively.

Figs. 204 to 213 are a few examples of diamond weaves repeating on twelve warp ends and picks uniformly, and are

given merely as suggestions indicating general methods of procedure in their development. In all cases their diamond formation is apparent, although they are not all actually based upon twill weaves produced in opposite directions. A careful examination will reveal the means by which the different results are achieved, and students are urged to make original designs of

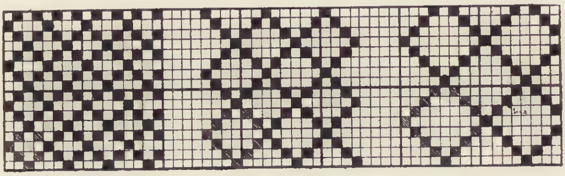


FIG. 198. FIG. 199. FIG. 200.

a similar character and so develop the faculty of invention in constructive textile design.

Honeycomb and Kindred Weaves.

§ 41. One of the most interesting varieties of weaves based, with few exceptions, on the diamond, are what are technically termed "honeycomb" weaves, from their partial resemblance to the hexagonal honeycomb cells of wax in which bees store their honey.

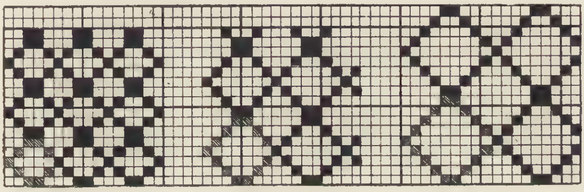


FIG. 201. FIG. 202. FIG. 203.

As previously stated, these weaves are characterised by a more or less distinct cellular formation, which imparts to cloth a somewhat rough and rugged appearance, as seen in Figs. 214 and 215, which are photographs of actual examples of cloth, representing two of the best-known varieties of this class of weaves, namely, "honeycomb" proper, and "Brighton" weaves, respectively. The peculiar character of texture resulting from honeycomb weaves in general, and particularly from those just

named, renders them eminently suited for use as bathroom towels, which require to be soft and absorbent, and for which use they are extensively employed. They are also very largely

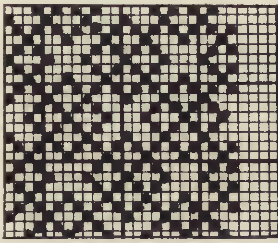


FIG. 204.

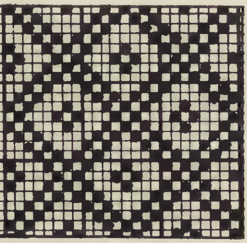


FIG. 205.

used in the production of heavy cotton and woollen textures for ladies' winter garments for both under and outer wear, and for

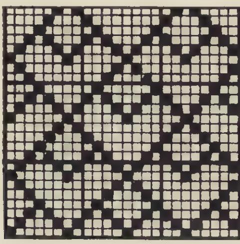


FIG. 206.

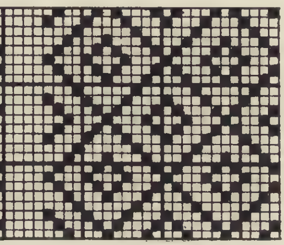


FIG. 207.

many domestic purposes. The well-known honeycomb counterpanes and toilet covers are so named from the almost exclusive

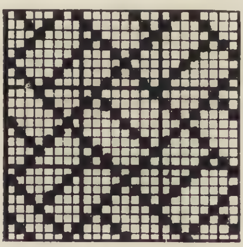
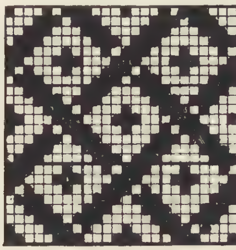


FIG. 208.

adoption of honeycomb weaves, as elements with which is developed the ornamentation peculiar to those fabrics, which

ornamentation is usually of an angular and linear geometrical character.

Although the peculiar effects of honeycomb weaves are



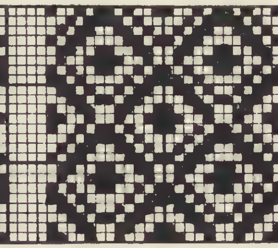
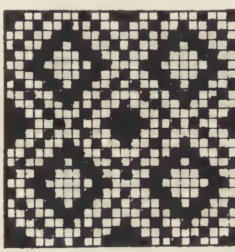


Fig. 209. Fig. 210.

primarily due to the particular methods of interlacement of warp and weft, those effects are relatively more pronounced in



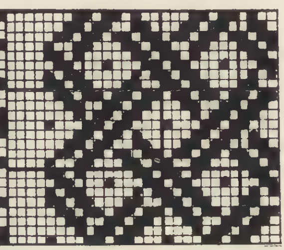


Fig. 211. Fig. 212.

compact textures produced from coarse and folded yarns, than in loose textures produced from fine and single yarns. For this

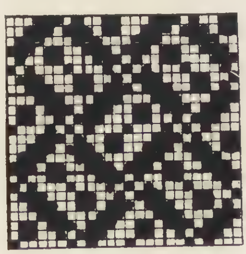


Fig. 213.

reason it is usual to weave them from folded yarn for warp, and frequently for both warp and weft, with a high number of

threads per inch. The samples of cloth illustrated by Figs. 214 and 215 are very heavy textures made from threefold 8's (equal to $8 \div 3 = 2\frac{2}{3}$'s single) cotton yarn for both warp and weft. The honeycomb sample contains 32 warp ends and 36 picks per inch, and the "Brighton" sample 44 threads of each series per inch.

Whilst conformable to the same general conditions, true honeycomb weaves may vary in detail of construction, but all

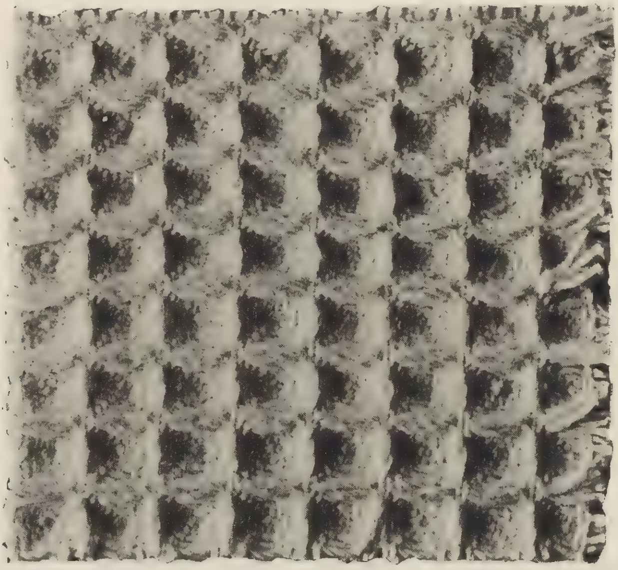


FIG. 214.—Cloth of Coarse Texture exemplifying a simple Honeycomb Weave.

must repeat on an even number of both warp ends and picks. Sometimes they are made to repeat on the same number of threads each way, and sometimes on a less number one way than the other, according to the ratio of warp ends and picks required in the fabric. If warp and weft are to be in equal quantities, the weave selected should repeat on the same number of threads of each series; but if one series of threads is in excess of the other, the pattern should repeat on such number of threads each way as most nearly corresponds to the ratio of

warp ends and picks per inch, otherwise the honeycomb cells would not be square in cloth.

Fig. 216 is the simplest example of a true honeycomb weave. The pattern repeats on six warp ends and four picks, with warp and weft on the face, and therefore at the back, in equal quantities, thereby causing both sides of cloth to be exactly alike—a feature not attainable in honeycomb weaves repeating on the same number of threads each way, in which either warp or weft must slightly preponderate. In the larger weaves, however, the difference is scarcely, if at all, perceptible.

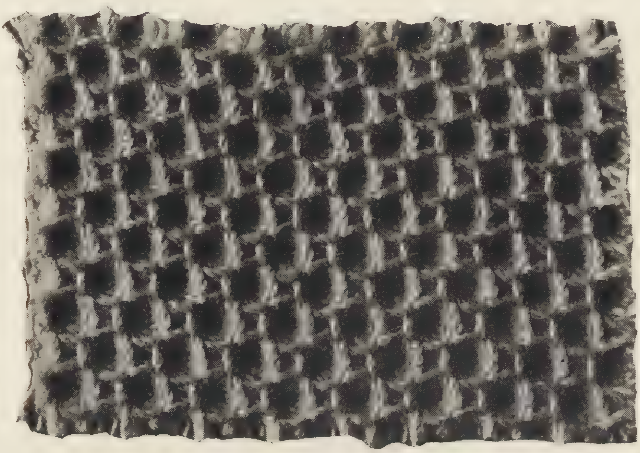


FIG. 215.—Cloth of Coarse Texture exemplifying a Honeycomb Weave of the variety termed "Brighton" Weaves.

Figs. 217A and 217B are designs showing the obverse and reverse sides, respectively, of the six-end honeycomb weave. As seen at 217A it appears as a simple six-end diamond weave, with alternate divisions, diagonally, filled in with a small warp diamond. The pattern is contained on 6 × 6 = 36 small squares, fifteen of which represent warp, and twenty-one represent weft. At 217B, however, which is the reverse of 217A, the ratio of visible warp and weft is also reversed. This variation will cause the cellular formation to be more pronounced, and therefore superior, on one side, according to the respective counts of warp and weft and the ratio of warp ends and picks per inch,

which data should be known to a designer to enable him to decide how to display the weave to the best advantage. For example, if a fabric were to be made with the same number of warp ends and picks per inch, from warp of slightly finer counts

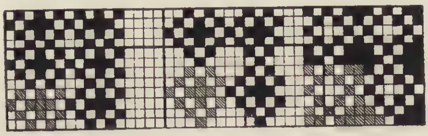


FIG. 216. FIG. 217A. FIG. 217B.

than that of weft, the best results would obtain from the weave shown at 217B, by reason of the longer float of finer warp compensating for the shorter float of coarser weft. If, on the other

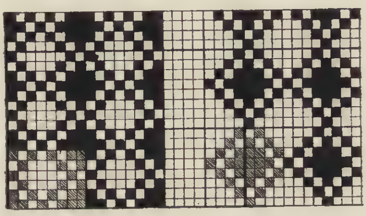


FIG. 218. FIG. 219.

hand, weft is to be a little finer than warp, the weave as given at 217A would give the best results, for similar reasons.

All other varieties of simple honeycomb weaves are constructed

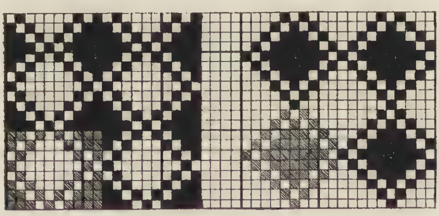


FIG. 220. FIG. 221.

in a similar manner to those given in Figs. 216, 217A and 217B, the difference being one of magnitude only. For example, Figs. 218 to 223 are honeycomb weaves of all sizes, from that contained on eight by six, to that contained on twelve by twelve

threads. It is rarely that the latter size of honeycomb weave is exceeded, excepting in fine textures containing a comparatively high number of warp ends and picks per inch. As the weaves increase in size, the threads are proportionately less frequently interlaced, thereby producing a weaker texture. It is advisable, therefore, to construct the larger weaves on the basis of what is

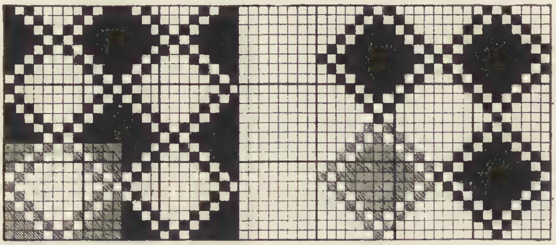


FIG. 222. FIG. 223.

termed a double-stitch diamond, as shown in Fig. 224, which forms the basis of the sixteen-end honeycomb weave given in Fig. 225. By thus increasing the degree of interlacement of threads, a fabric of firmer texture is produced without destroying the salient features of the honeycomb weave.

At the outset of these observations on the construction of diamond weaves, it was stated that their diamond formation

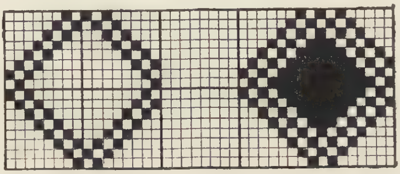


FIG. 224. FIG. 225.

may be more or less pronounced, or even entirely obscured, as in honeycomb and similar weaves, which are characterised by a more or less distinct cellular formation. This is easily observed in Figs. 214 and 215. In the former, which is a twelve-end honeycomb weave proper, the rectangles are of uniform size, whilst in the latter, which is a twelve-end "Brighton" weave, the rectangles are of two sizes, a large and small one alternately, both longi-

tudinally and transversely. In neither case is their diamond origin apparent, nor is there any resemblance between the woven effects and their respective designs (as represented on design paper), as is usual with most weaves. The cause of this phenomenon will be understood on reflecting that warp and weft cross at right angles to each other, and that threads are more or less conspicuous according as they are interlaced in a lesser or greater degree respectively. Thus it comes about that the ridges of honeycomb cells are formed by the longer floats of warp and weft, which lie uppermost, whilst the recesses are caused by threads interlacing to a greater degree in those parts.

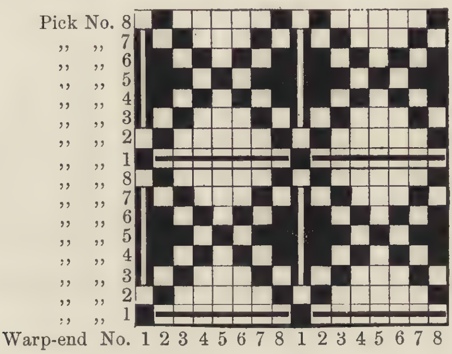


FIG. 226.—To demonstrate the Cellular Formation developed by Honeycomb Weaves.

By reference to the eight-end honeycomb weave, Fig. 226, it will be seen that the ridges of the cells are formed by the first warp end and first pick of weft—in each repeat of the pattern—which are least interlaced, and therefore lie in a higher plane than the threads on each side of them. The threads lie in a lower plane, as their length of float diminishes, up to the fifth warp end and pick, which lie in the lowest plane and form the recesses of the cells.

"Brighton" Weaves.

§ 42. "Brighton" weaves are also constructed on a diamond basis, yet they are quite different from simple honeycombs, and more complex in structure. They are characterised by a cellular

formation comprising two sizes of cells, as seen in Fig. 215. Unlike simple honeycomb weaves, "Brighton" weaves are not reversible, but have a totally different appearance on each side of the fabric. Instead of clearly defined cells, as on the face of the fabric, the reverse side presents a rough, indefinite appearance, the cause of which will be presently explained. This circumstance requires to be carefully borne in mind by designers when employing "Brighton" weaves as elements in the development of ornamental designs, otherwise the designs are liable to be spoiled.

Examples of "Brighton" weaves are given in Figs. 228, 229 and 230. It is noteworthy that they may only be constructed on a multiple of four threads of warp and weft (the least size being contained on eight warp ends and eight picks, as shown in Fig.

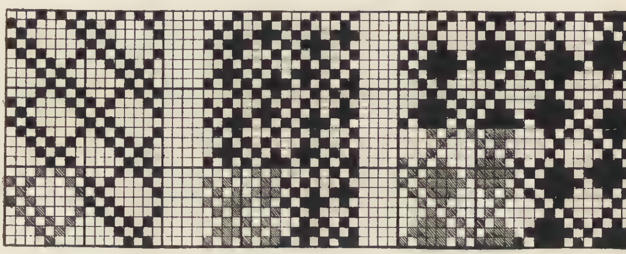


FIG. 227. FIG. 228. FIG. 229.
Showing the construction of "Brighton" Weaves.

228). They are constructed on a diamond formed by producing a simple weft twill to the right or left (for such number of threads as the weave is required to repeat on, say eight), and then crossing it by a double-stitch weft twill, as in Fig. 227. The next step is to put in a **warp** diamond spot in the **right** and **left** corners of each diamond, so as to form a **weft** diamond spot in the **upper** and **lower** corners. The longer floats of warp at the sides, and the longer floats of weft at the top and bottom of each diamond, form the ridges of the cells as explained in the last paragraph of § 41. The two sizes of cells are caused by the intervals between the ridges being greater and less, thereby enclosing larger and smaller areas alternately. If the relative positions of the warp and weft diamond spots are reversed, the weave will be the wrong side up by reason of the longer floats

forming a *cross*, instead of a *square*, within the diamonds. A parallel reference to Figs. 230 and 231 will enable this to be easily understood. Fig. 230 is a perfect sixteen-end "Brighton" weave with the warp and weft spots in their proper relative positions,

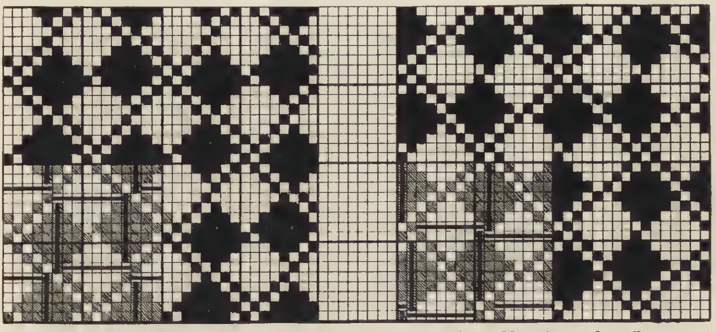


FIG. 230.—Showing the Correct Method of constructing "Brighton" Weaves.

FIG. 231.—Showing the Incorrect Method of constructing "Brighton" Weaves.

showing the squares formed by their longer floats. Fig. 231 has the same diamond foundation, but the warp and weft diamond spots are placed in the *wrong* relative positions, thereby causing their longer floats to form a cross within each diamond, as shown.

"Sponge" Weaves.

§ 43. In addition to the true honeycomb and "Brighton" weaves there is a great variety of weaves termed "honeycomb

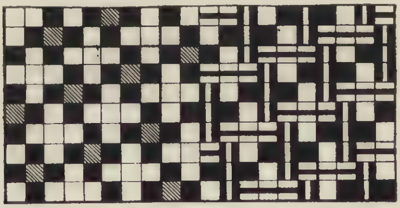


FIG. 232.—To demonstrate the Cellular Formation developed by "Sponge" Weaves.

effects," that are closely allied to those weaves, and which possess, in varying degrees, many of their characteristics. They are extensively employed as constructive elements in the de-

velopment of Jacquard designs for honeycomb counterpanes, toilet covers and fancy woollen shawls, as well as in the production of piece-goods of comparatively heavy and thick textures, for use as ladies' winter underclothing, towels, and many other domestic purposes. They are usually characterised by a cellular

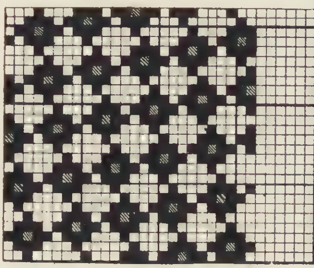


Fig. 233.

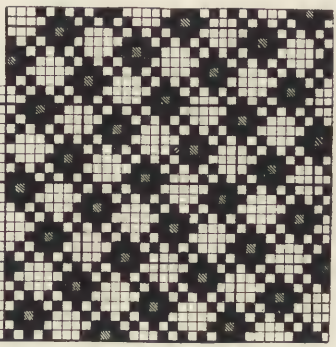


Fig. 234.

formation, but of a less pronounced character than that of a perfect honeycomb. This chiefly arises from adopting a less restricted basis than that of a diamond on which to construct them, as, for example, a satin-weave basis, which gives a free distribution ; broken diamonds ; and irregular bases that cannot be exactly defined.

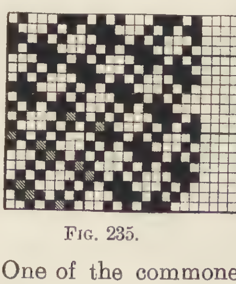


Fig. 235.

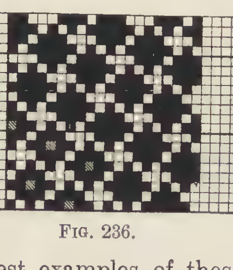


Fig. 236.

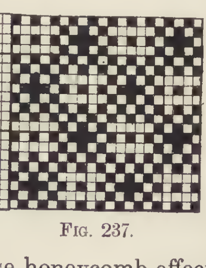


Fig. 237.

One of the commonest examples of these honeycomb effects is that known as the "sponge" weave (Fig. 232), contained on ten warp ends and ten picks. It is produced by disposing a small diamond figure or spot on a ten-end satin basis, as indicated by the shaded squares in the portion lettered A. This

causes the woven fabric to assume a very neat cellular formation consisting of minute cells, the ridges of which are formed by floats of warp and weft, whilst the recesses are formed where the threads are most interlaced. This effect is illustrated in the

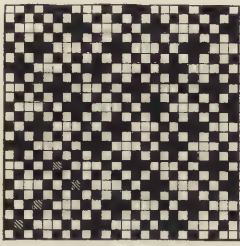


Fig. 238.

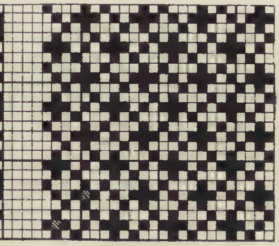


Fig. 239.

portion lettered B, where the warp and weft ridges are represented by white and black lines respectively, and the recesses by the enclosed spaces.

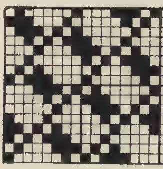


Fig. 240.

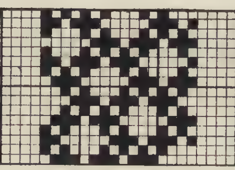


Fig. 241.

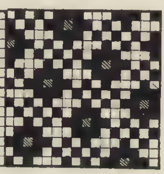


Fig. 242.

Figs. 233 and 234 are other varieties of sponge weaves on a larger scale than the previous one. They are produced by arranging larger diamond spots on the basis of a twenty-six shaft, and a

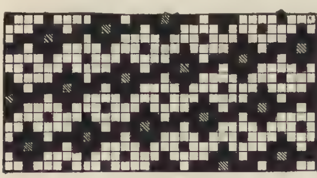


Fig. 243.

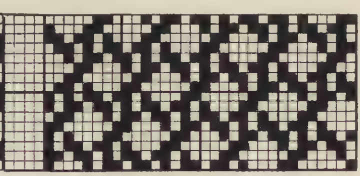


Fig. 244.

thirty-four shaft satin weave, respectively, as indicated by the shaded squares. Their effect in cloth is similar to that of Fig. 232, but with a more pronounced cellular formation, resulting

from longer floats and less frequent interlacing of yarn, which enable heavier and thicker fabrics to be made by them. Figs. 235 to 244 are other examples of sponge and honeycomb effects, and are but a few of many varieties of similar character to indicate the general principles governing the construction of that class of weaves.

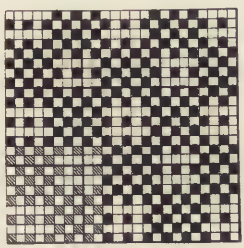


FIG. 245.—" Huck-a-back " Weave.

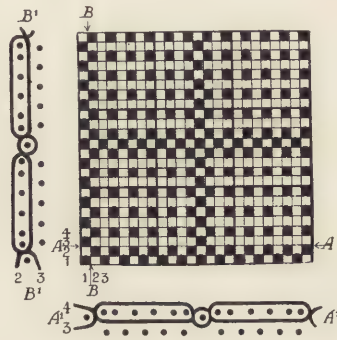


FIG. 246.

" Huck-a-Back " and Kindred Weaves.

§ 44. There are many other varieties of weaves which, whilst not bearing even the slightest resemblance to true honeycomb weaves, are generally associated with honeycomb fabrics, and

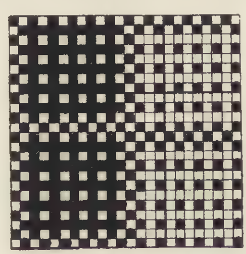


FIG. 247.—Design for " Huck-a-back " Cloth represented by Fig. 248.

are, therefore, classed as honeycomb effects. Of this variety that known as the " huck-a-back " weave, shown in Fig. 245, and contained on ten warp ends and picks, is an example. This familiar weave is also very largely employed in the manufacture of both linen and cotton towels for bathrooms, and also linen

towels for use as glass-cloths. The principle of fabric structure embodied in the huck-a-back weave forms the nucleus of a wide range of interesting weaves capable of producing extremely thick and heavy textures. For this reason, such weaves are generally employed as constructive elements in the manufacture of the class of heavy counterpanes commercially known as "Grecians," usually woven from bleached twofold and threefold yarn of coarse counts for both warp and weft, and ornamented with

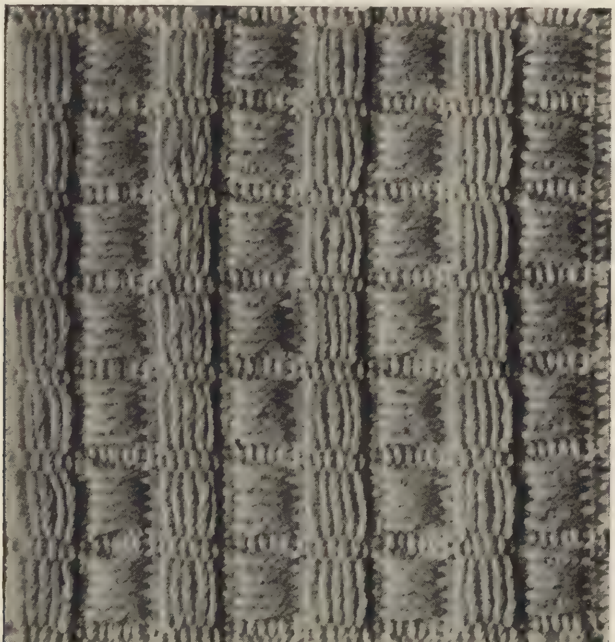


FIG. 248.—"Huck-a-back" Fabric of Coarse Texture, woven from Design Fig. 247.

designs of a strictly geometrical diaper character. Figs. 246 to 249 are three examples of weaves showing developments of the "huck-a-back" principle to form plain, striped, and chequered effects respectively. In a fabric produced from Fig. 246, which repeats on twelve warp ends and picks, weft preponderates on the face and warp at the back. On examining this weave it will be seen that on the third and following odd-numbered picks

to the eleventh, only the first warp end in each repeat of the pattern is raised ; also that the third and following odd-numbered warp ends to the eleventh, are raised for the first pick only in each repeat of the pattern. This has the peculiar effect of causing warp and weft threads (excepting the first of each series) to occupy

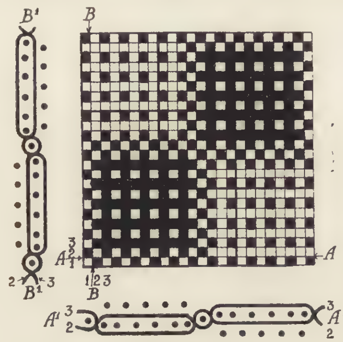


FIG. 249.

four distinct planes or strata without any interlacement whatever, after the manner indicated in the accompanying diagrams, which show transverse and longitudinal sections of the weave at A, A, and B, B, respectively. It is in consequence of causing such disposition of warp and weft that weaves of this class pro-

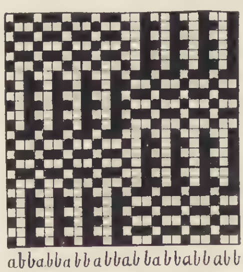


FIG. 250.—Design for "Huck-a-back" Cloth represented by Fig. 251.

duce bulky fabrics of great weight and warmth. Fig. 247 is a design contained on twenty-four warp ends and twelve picks, produced by counterchanging the warp and weft effects of Fig. 246 to form stripes; whilst Fig. 248 is a photograph of a woven example of the same weave produced from 3/12's warp and weft, and containing thirty-two threads of each series per inch.

Fig. 249 is a design produced by counterchanging warp and weft effects of the same weave to produce a check pattern repeating on twenty-four warp ends and picks. The diagrams accompanying Fig. 249 show transverse and longitudinal sections at A, A, and B, B, of that design as it would appear in cloth. Fig. 250 is another good example of the huck-a-back variety of designs,

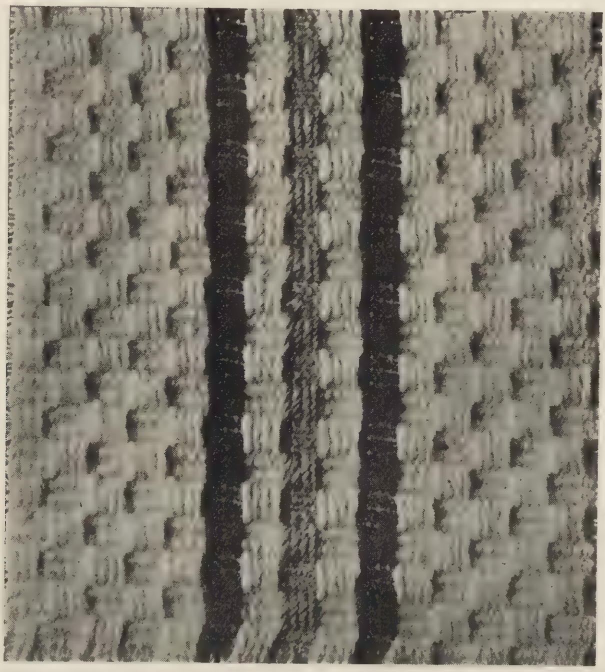


FIG. 251.—A second example of "Huck-a-back" Cloth, woven from Design Fig. 250.

repeating on twenty-four warp ends and twelve picks. The photograph, Fig. 251, showing the woven effect of that design, is taken from cloth containing forty warp ends of 3/12's, and twenty of 2/14's cotton, and forty picks of 18's single cotton weft per inch. The different counts of warp are contained on separate warp beams, with the 2/14's (lettered *a* on the design) held at greater tension, during weaving, than the 3/12's (lettered *b*). Taut warp ends interweave with weft in plain or tabby

order throughout; whilst slack warp ends are more loosely interwoven to form the figured effect.

"Grecian" Weaves.

§ 45. Another useful variety of weaves that are frequently associated with honeycomb and "Grecian" counterpanes, and

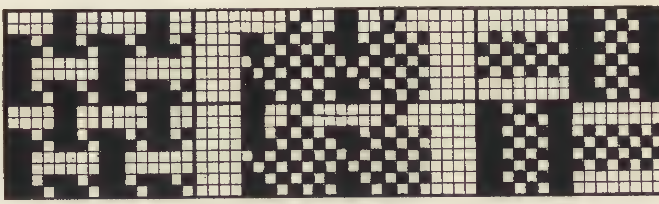


FIG. 252. FIG. 253. FIG. 254.

also largely employed in the manufacture of piece-goods, are exemplified in Figs. 252 to 265. The most suitable designs for

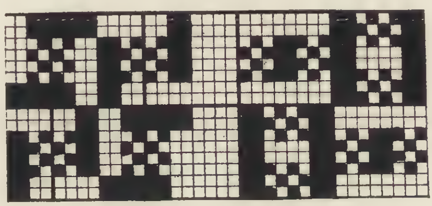


FIG. 255. FIG. 256.

such fabrics are those based on the diaper or counterchange principle, to produce chequered effects in which both warp and

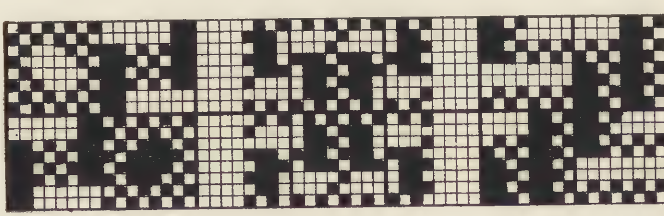


FIG. 257. FIG. 258. FIG. 259.

weft are freely displayed on the face side of cloth. The construction of weaves of this variety affords considerable scope for

the exercise of a student's ability in fabric structure, which he should put into practical effect, and carefully note the results.

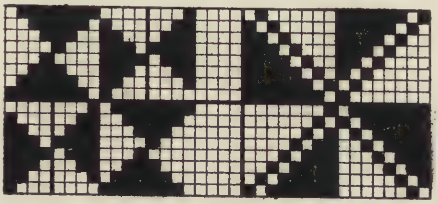


FIG. 260. FIG. 261.

Little can be said respecting their construction, since they are

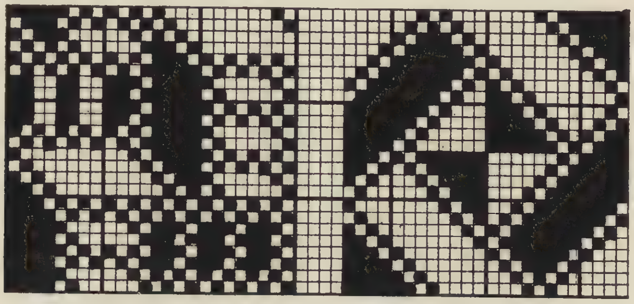


FIG. 262. FIG. 263.

conformable to no special conditions of fabric structure; but, by

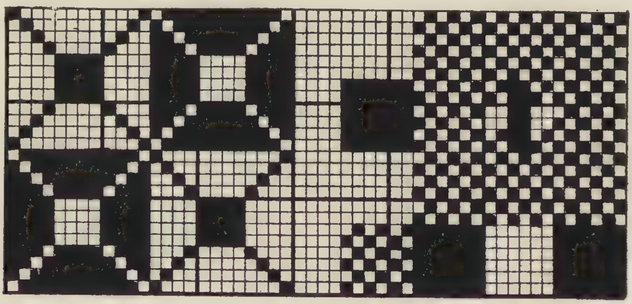


FIG. 264. FIG. 265.

carefully analysing them, the means by which they are obtained will become manifest. For the general guidance of students,

however, it should be observed that these effects are chiefly dependent upon either a suitable combination of extreme degrees of interlacement of threads, or else by causing warp ends to float over a comparatively large number of picks; and picks of weft over a large number of warp ends; otherwise, unsatisfactory results would obtain. If, for example, the present weaves (excepting Fig. 255) were counterchanged, their effects would be lost by reason of an insufficiency of floating

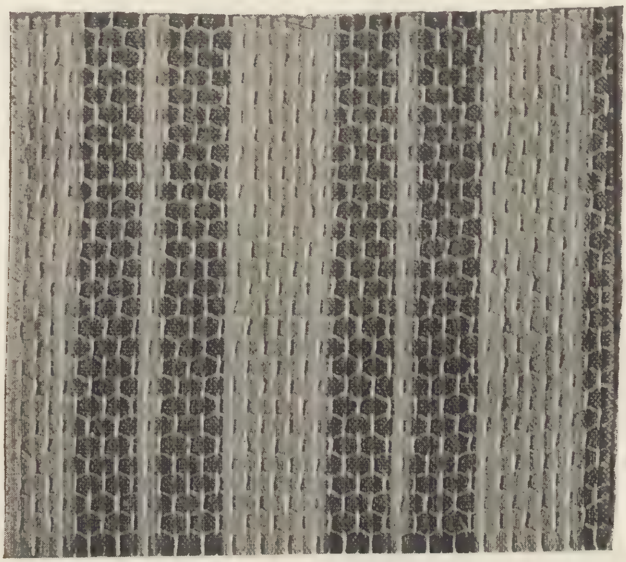


Fig. 266.—A Fabric of Light Texture, exemplifying a "Linear Zigzag" effect produced by Design Fig. 267.

threads. Fig. 255 is an exception to this condition, as that weave would be equally effective whether counterchanged or not, and would, therefore, appear the same on both sides of cloth.

Linear Zigzag Weaves.

§ 46. An interesting variety of weaves of a totally different character from any previously described under "honeycomb effects," but closely related to them, are those in which some threads, usually of weft, are pulled in opposite directions at

different points, thereby causing them to deviate from their original straight line, and to assume sinuous lines of a more or less wavy or zigzag character, not unlike that of a "net" leno effect, produced by means of a "doup" or "leno" harness. The threads required to perform that peculiar function may be waved in the same direction uniformly, to produce a series of parallel waves, or they may be waved in opposite directions to produce diamond, lozenge, ogee, and other simple linear effects, as seen in Figs. 266 and 274, which are reproduced from actual examples of cloth. This phenomenon of fabric structure occurs in obedi-

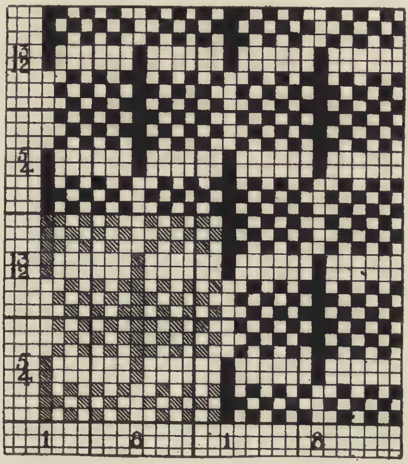


FIG. 267.—The Design for the "Linear Zigzag" effect represented by Fig. 266.

ence to the law of bodies yielding in the direction of least resistance, and forms an interesting and instructive study of the behaviour of threads in textile fabrics. By taking advantage of the opportunities it affords, a great variety of very pleasing decorative effects may be developed in cloth, the character of which effects is chiefly dependent upon the relative density or compactness of different parts of a weave, and upon the particular manner of interlacing threads. Thus, by so developing a weave that warp and weft are more thoroughly interwoven, and therefore more compacted, in some parts than in others (and by observing such other conditions as to the manner of inter-

weaving as will contribute to the desired effect), it will cause some threads to pass from the denser towards the less compact portions, and so become more or less diverted from a straight line,

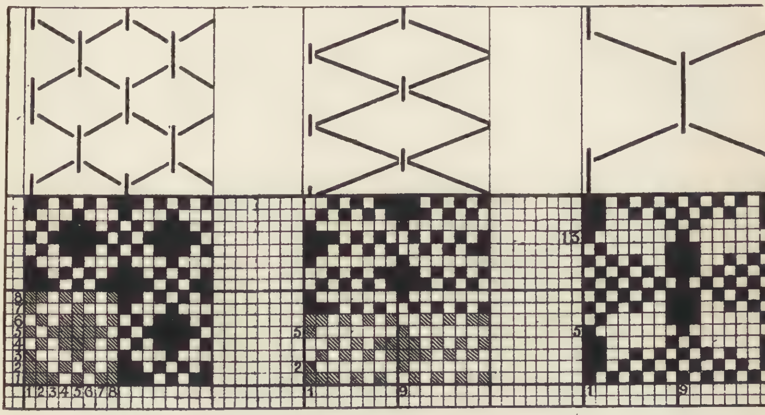


FIG. 268. FIG. 269. FIG. 270.

in proportion to the relative density of threads in those parts. These remarks will be easily comprehended after carefully study-

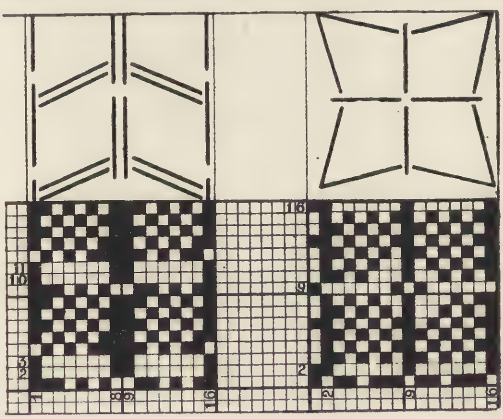


FIG. 271. FIG. 272.

ing the present examples of these weaves, in conjunction with their accompanying diagrams illustrating their effects in cloth. Weaves of this character (which, as a means of identification,

the present writer ventures to suggest the name of "linear zigzag" weaves) are sometimes produced on a small scale in light cotton and silk textures for ladies' summer attire. They assume a more vigorous character, however, when developed with coarser material to produce heavier textures (as honeycomb and "Grecian" counterpane, and similar fabrics), and by densely crowding that series of threads which are required to perform the bending. Thus, if *weft* threads are required to

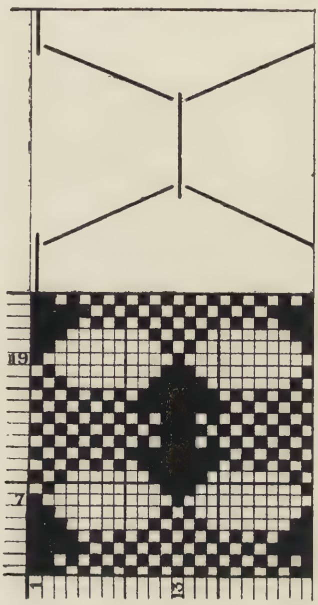


Fig. 273.—Design for Fabric represented by Fig. 274.

assume a zigzag course, a more pronounced effect will result from a high ratio of picks per inch, and from a high degree of tension upon warp ends during weaving. If, on the contrary, *warp ends* are required to bend out of a straight course, they should be more numerous than picks, and held at less tension; whilst the tension of weft, as it leaves the shuttle, should be increased. It should be observed, however, that better zigzag effects are produced with weft than with warp, as warp ends

may be held at greater tension during weaving, which enables a relatively greater number of picks to be inserted in cloth.

Figs. 266 to 276 are examples of "linear zigzag" weaves, with diagrams showing their woven effects placed immediately above them to facilitate comparison. Fig. 266 is a full-scale photograph of a sample of light zephyr cotton dress fabric of the plain or calico weave, on which are developed a series of

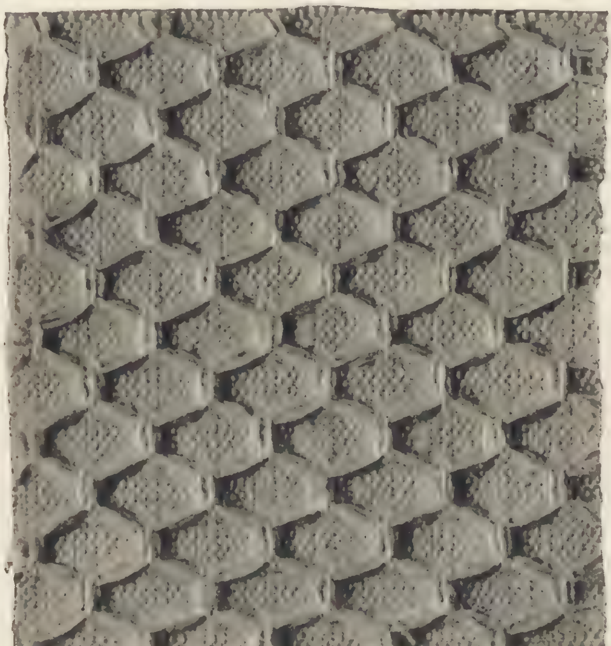


FIG. 274.—A Fabric of Coarse Texture, exemplifying a "Linear Zigzag" effect produced by Design Fig. 273.

linear figures of hexagonal formation similar to that above Fig. 268. The cloth is woven from the design Fig. 267, contained on fourteen warp ends and sixteen picks, and has ninety warp ends and seventy-six picks per inch. The floating warp threads, numbered one and eight on the design, which pull at opposite sides of the floating picks numbered four, five, twelve, and thirteen, are of stronger yarn than the other warp ends; the counts being

2/60's and 40's T., respectively; whilst the weft is 40's counts throughout. There is little or no resemblance between the design and its woven effect; but a little consideration will enable those previously unacquainted with this class of weaves to understand the cause of that difference. It will be observed that picks numbered four, five, twelve, and thirteen never interweave with warp ends, but simply lie above them all, excepting those numbered one and eight, which always overlap those picks

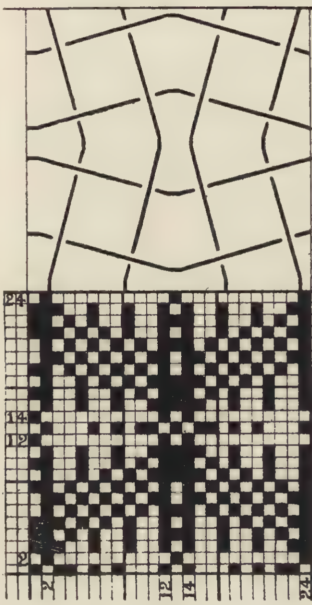


FIG. 275.

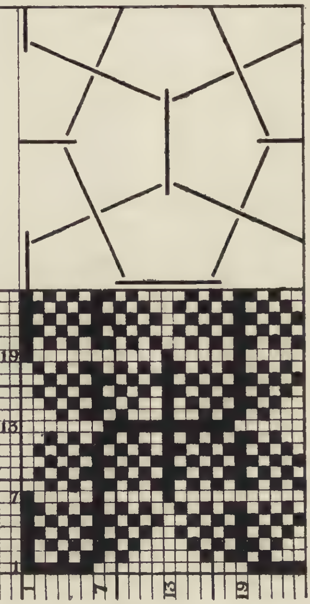


FIG. 276.

from opposite sides. The floating picks, therefore, form no integral part of the fabric; for during weaving, the adjacent picks close in, so that warp ends which appear to float over ten picks in the design, float over only six picks in cloth. Thus, in consequence of being overlapped by those warp ends, the floating picks are pulled in opposite directions out of their previous straight line, and produce the linear zigzag effect seen in cloth.

Figs. 268 to 276 are examples of linear zigzag weaves based

on this principle of weaving, and are sufficient to indicate the variety of effects which it affords. Fig. 274 is a full-scale photograph of cloth woven from the design, Fig. 273, which repeats on twenty-four warp ends and picks. The cloth contains thirty-six warp ends and picks per inch of 3/16's yarn throughout, which produces a somewhat bold effect.

CHAPTER V.

BEDFORD CORDS.

§ 47. Bedford cords are a variety of fabrics characterised by a series of more or less pronounced plain or twilled ribs or cords, lying in the same direction as warp ends, with weft floating somewhat freely at the back of the ribs, and usually with one, two or more wadding threads (according to width of ribs) lying loosely between. They are developed by causing either *alternate picks* of weft, or *alternate pairs of picks*, to interweave with the warp ends of one rib and then pass underneath those of the next rib, alternately; whilst the intermediate picks or pairs of picks pass under the first rib, and interweave with the second rib, alternately. Consequently, odd-numbered picks or pairs of picks always interweave with warp ends of the same (say odd) series of cords throughout, whilst the other picks always interweave with the even series of cords. This circumstance is helpful for the purpose of producing stripes of solid colours by picking with corresponding colours of weft in such manner that they only interweave with warp ends of the same colour, and float underneath those of the other colour. These features are clearly discernible in the photograph (Fig. 277) which shows the face and back of the same cloth.

Bedford cords are produced in a variety of both cotton and worsted textures, varying from light to relatively heavy cloths, according to the particular use for which they are intended. The lighter and medium fabrics are chiefly used as ladies' dress materials; whilst the heavier and coarser fabrics are generally made up into men's clothing of a special character, as fancy vests, breeches, sporting and riding suits, and such like. The lighter cotton textures are usually bleached, or else dyed in tints

of some light and bright hue, for ladies' light summer and holiday clothing. Generally speaking, Bedford cords afford little scope for variation of structure. This, however, is compensated for by the fair scope they offer to simple decorative effects, either by means of variegated cords, coloured threads of warp, or Jacquard weft figuring of an elementary and bold character, and consisting preferably of small detached sprigs or simple geome-

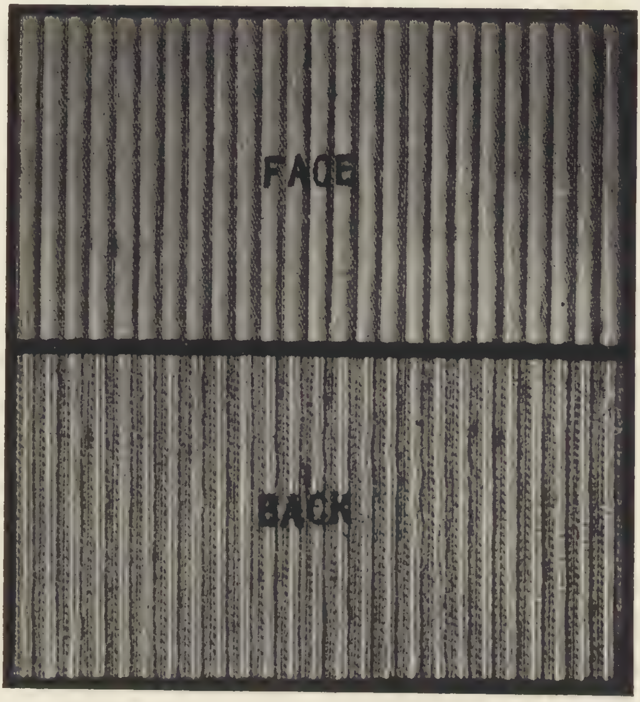


FIG. 277.—Bedford Cord Fabric, woven from Design Fig. 282.

trical forms evenly distributed in such manner as to ensure that all warp ends shall bear the same degree of tension. Coloured threads may be introduced either as extra or crammed warp ends for figuring purposes, or in substitution for ordinary warp ends for coloured effects only. When Jacquard figuring is adopted in Bedford cords, it is virtually a system of brocade weft figuring with a Bedford cord for a ground filling.

For the purpose of giving the ribs or cords greater prominence and also to increase the weight, bulk and strength of the fabric, one, two or more extra warp ends are sometimes introduced in each cord to serve as wadding. These extra threads never interlace with weft, but lie perfectly straight between the ridges of their respective cords and the floating weft at the back. In addition to wadding threads, some of the heavier fabrics for men's clothing contain backing warp ends that interweave with weft at the back of the cloth only, thus forming a series of tubes along which wadding threads lie straight, and which considerably increase the stability and warmth of the fabric. With few exceptions wadding threads are of considerably coarser counts of yarn than the principal or face warp ends, and since they never interlace with weft, but remain straight, their contraction during weaving is *nil*. This circumstance necessitates their being wound upon a separate warp beam, and held at greater tension than face warp ends during weaving.

It may be observed, at this juncture, that Bedford cords of low quality and somewhat open texture are usually woven face downwards, so that fewer healds require to be raised; thereby requiring less motive power to drive the loom, and reducing the wear and tear of healds and shedding mechanism. These considerations, however, are sacrificed in the production of superior qualities which are woven face side upward to permit of the readier detection of broken warp ends, and other faults liable to occur during weaving.

The present examples of Bedford cord weaves are of fabrics selected as typical specimens of their class from those of ordinary commerce. In all cases, both heald and reed drafting are indicated above their respective designs, with such other information as will be helpful to students; and the present chapter will conclude with an instructive table giving complete data of the manufacture of each example.

§ 48. Fig. 278 is a design of a light Bedford cord of the most elementary character devoid of wadding threads. Each rib contains eight warp ends, which interweave on the plain or calico principle with one-half of the picks of weft, thereby causing the complete design (consisting of two cords) to repeat on sixteen

warp ends and four picks. The first and last warp ends of each cord, termed "cutting" threads, interweave on the calico principle with *all* picks of weft, thereby forming a furrow or "cutting," which sharply divides the cords; whilst the intervening warp ends, termed "face" threads, interweave on the calico principle with alternate pairs of picks only, and lie com-

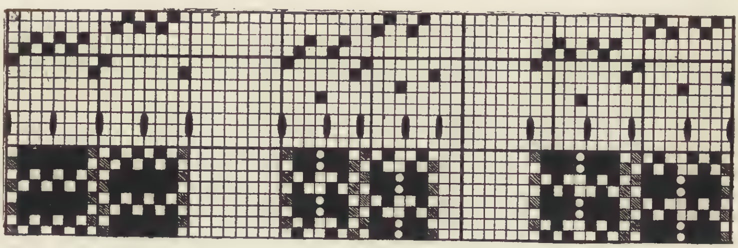


FIG. 278. FIG. 280. FIG. 281.

pletely above the intermediate pairs of picks, as clearly indicated in the diagram, Fig. 279, showing a transverse section of cloth woven from the design, Fig. 278. The production of this cloth involves the employment of six heald shafts, namely, four in the rear for face threads, and two at the front for cutting

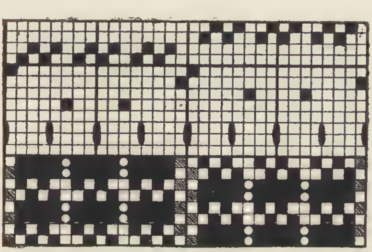


FIG. 282.—Design for Bedford Cord Fabric represented by Fig. 277.

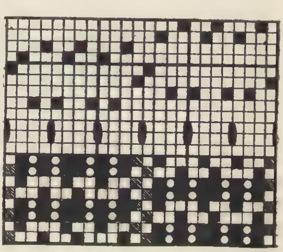


FIG. 283.

threads. Warp ends are drafted in the manner indicated above the design, with four threads in each dent of the reed, and a reed wire separating the cutting threads. Each cord, therefore, occupies two dents of the reed.

Fig. 280 differs in construction from Fig. 278 chiefly by the introduction of a wadding thread (indicated by white dots) in each cord. Wadding threads are drawn through two healds

FIG. 279.—Transverse Section of Bedford Cord, woven from Design Fig. 278.

placed immediately in front of those governing cutting and face threads respectively, in accordance with usual practice. Sometimes the healds governing cutting threads are placed in front, followed by, those governing wadding and face threads respectively; but this is quite optional. It will be seen that wadding threads are always raised along with all face threads of the same cords when it is required to place weft at the back; but they remain down when weft interweaves with face threads, to form the ridge of a cord, whereby they lie between the face of a cord and the floating weft.

Fig. 281 is similar to Fig. 280, with two additional face threads per cord, and each cord occupying two dents of the reed. Figs. 282 and 283 have two and four wadding threads in each cord, and occupy four and three dents per cord respectively. Fig. 284 is a Bedford cord occupying twenty warp ends, including eight wadding and two cutting threads drawn through five dents of the reed. Fig. 285 is a variegated cord with one broad and two narrow cords alternately. The broad cord occupies twenty-six warp ends, including four of wadding, drawn through seven dents; whilst the narrow cords each occupy eleven warp ends, including one of wadding, drawn through three dents, making a total of forty-eight warp ends for the series. Since three cords constitute an odd series, the drafting of warp ends for this design requires to be extended to include two series of

cords to make an even number, and so conform to the practice, common to Bedford cords, of causing weft to interweave with the warp ends of alternate cords, and float under those of intermediate cords.

§ 49. Figs. 286 and 288 are slight deviations from the previous examples, in that *alternate picks* of weft interweave with face warp ends of alternate cords, and float behind the intermediate cords; whereas, in the former examples, *two contiguous picks* either interweave or float at the same time. There is little difference between the two systems, but slightly superior results obtain with the alternate arrangement of picks, as they are more perfectly distributed in cloth. It is also capable of producing a closer texture, and forms a clearer cutting between the cords, which appear more distinct. Fig. 286 is an uncommon variety

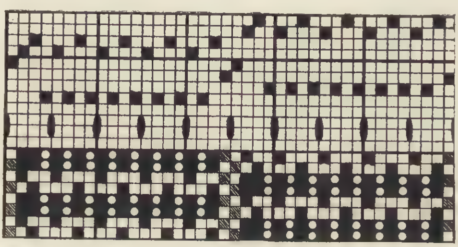


Fig. 284.

of Bedford cord, inasmuch as there are no cutting warp ends. The development of the ribs is, therefore, entirely dependent upon each pick of weft interweaving with and floating under alternate groups of warp ends. In the present example there are eight face and two wadding threads per cord drawn through three dents of the reed. Fig. 287 is a transverse section of cloth woven from the design Fig. 286. Fig. 288 is a cord similar to the previous one, but having cutting threads and a greater number of face threads in each cord, which occupies sixteen warp ends drawn through four dents of the reed.

§ 50. Figs. 289 to 292 are examples of Bedford cord weaves in which the ribs or cords are developed with a three-end ($\frac{2}{1}$) twill, with alternate picks of weft interweaving with alternate cords, and then floating beneath intermediate cords; whilst the inter-

mediate picks interweave with and then float beneath the intermediate series of cords. This alternate disposition of picks appears to be uniformly observed in the production of twilled Bedford cords, whereas it obtains in a lesser degree than the two-and-two disposition of picks in the production of Bedford cords having the ribs developed with the plain or calico weave, as exemplified in Figs. 278 to 284. It is in respect of the twill weave and the uniform alternate disposition of picks that the present examples of Bedford cords differ from those previously described. These, like those, may or may not be devoid of wadding warp ends, according to the weight and character of texture required. As a rule, twilled Bedford cords are more compact and comparatively softer and more supple than the calico - ribbed variety, consequent upon a lesser degree of interlacement of warp and weft.

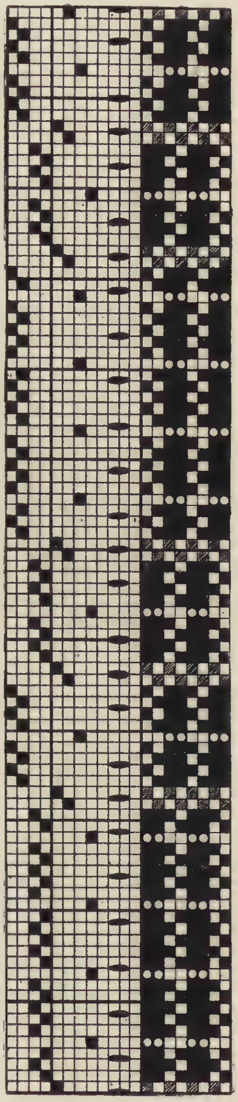


Fig. 285.—Design for Variegated Bedford Cord.

Fig. 289 is an example of a twilled Bedford cord devoid of wadding warp ends. Each cord occupies nine warp ends, including two cutting threads, drafted on eight healds and drawn through three dents of the reed, as indicated above the design. Fig. 290 is a twilled cord occupying six face, two wadding and two cutting warp ends per cord, drafted on twelve healds and drawn through three dents of the reed. Fig. 291 is a twilled cord occupying eighteen

face, five wadding and two cutting warp ends drawn through six dents of the reed. The fabric from which this design was obtained contained six cords per inch (when in the loom), equal to 120 warp ends (excluding wadding threads) per inch. This comparatively high number of threads produces somewhat flattened ribs resembling tucks, which slightly overlap each other.

§ 51. All the foregoing examples of Bedford cords are of light and

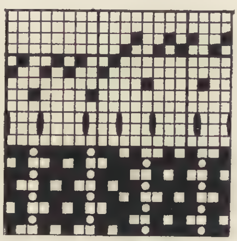


Fig. 286.—Design for Bedford Cord Fabric, of which a Transverse Section is represented by Fig. 287.

medium textures suitable for ladies' dress material. The two following examples, Figs. 292 and 293, are of heavy textures such as are employed for men's sporting suits. Fig. 292 occupies thirteen face, seven wadding and two cutting warp ends drawn through five dents of the reed. Fig. 293 is a full-scale photograph of an interesting variety of Bedford cord of a specially heavy and strong texture, and with wide prominent ribs. Its construction is very different in many respects to any of the previous ex-

Fig. 287.—Transverse Section of Bedford Cord, woven from Design Fig. 286.

amples. In addition to wadding threads, it contains "backing" warp ends; also picks of weft comprise two distinct series, namely (*a*) face, and (*b*) back picks, inserted in the proportion of one face and two back picks alternately. Face picks interweave with *face* warp ends of *successive* cords, whilst back picks interweave with *back* warp ends of successive cords, thus

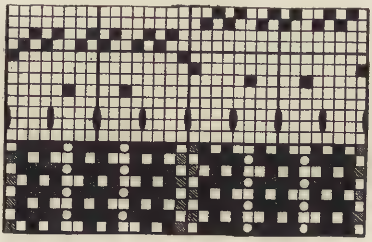


Fig. 288.

forming a series of tubes along which wadding threads lie straight. As indicated in the design, Fig. 294, each cord occupies a total of twenty-nine warp ends, of which eighteen are "face," three "cutting," four "wadding" and four "backing" warp ends. Only two warp beams are necessary to con-

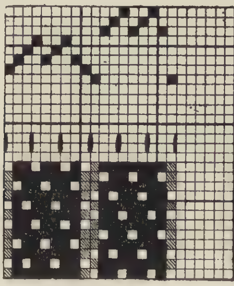


Fig. 289.

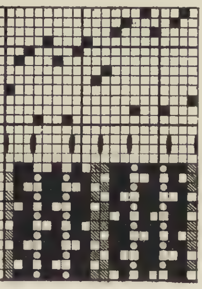


Fig. 290.

tain the four series of warp ends, namely, one for face and cutting threads (whose rate of contraction during weaving is equal), and one for wadding and back warp ends, which are held at greater tension than face and cutting threads. Two counts of yarn are employed in the production of this example, namely, 2/60's for cutting, and 2/16's for face, wadding and back warp

ends (the latter being sized); also 2/16's weft of similar yarn to the warp ends for both face and back picks. Cutting threads (represented by shaded squares) interweave in the plain or calico order with successive picks of weft. Face warp ends (filled

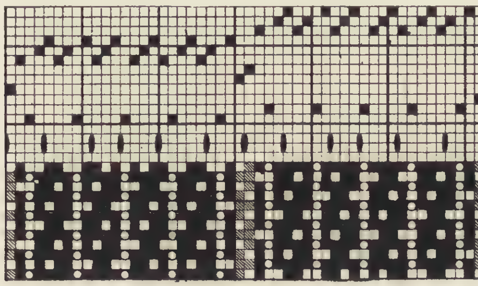


Fig. 291.

squares) interweave with face picks only (every third pick) to produce a three-end ($\frac{2}{\ 1}$) twill, and are raised when back picks are inserted. Back warp ends (round black dots) interweave with back picks (two out of three) on the calico principle, but with

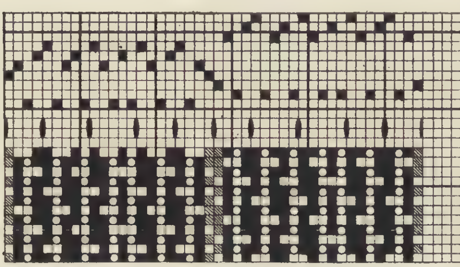


Fig. 292.

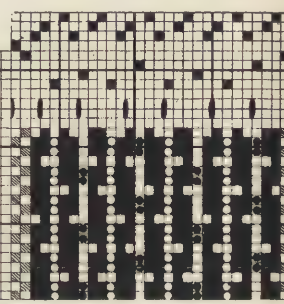


Fig. 294. — Design for Bedford Cord Fabric represented by Fig. 293.

the picks running together in pairs instead of separately. Wadding threads (round white dots) never interweave with weft, but are simply raised when back picks are inserted, and depressed when face picks are inserted, to cause them to lie loosely between the face and back of the fabric.

§ 52. All the examples of Bedford cords described above are of a strictly plain or unfigured character. It now only remains, to make their description more complete, to describe the usual methods adopted for their embellishment. At the outset of these observations, it was stated that Bedford cords were capable of decorative treatment by means of coloured threads and by simple Jacquard figuring. If coloured threads are merely sub-

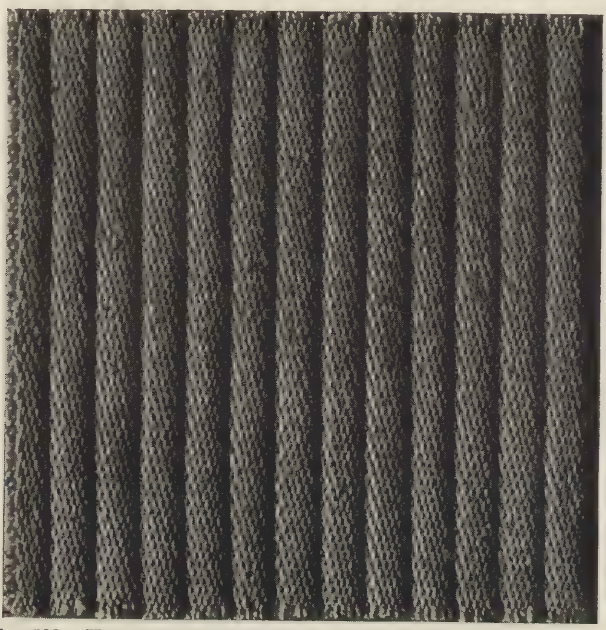


FIG. 293.—Heavy Texture of Bedford Cord, woven from Design Fig. 294.

stituted for undyed threads, other conditions remain unchanged; but if they are additional threads for figuring purposes, they require to be governed by extra healds. Coloured threads are sometimes substituted for wadding threads in certain cords at required intervals, and employed for the development of simple figured effects. In such instances, figuring threads do duty for wadding threads when not required on the face for figuring purposes, with the result that they tend to impart a tinge of colour to those cords containing them. A more satisfactory

method of introducing coloured threads is exemplified in Figs. 295 and 296. In Fig. 295 a neat wave stripe is developed at intervals by means of four coloured additional warp ends, represented in the design (Fig. 296) by crosses. One unit of the pattern comprises five cords, namely, a broad one containing the extra figuring warp ends, and four narrow plain ones, thereby requiring two units of the pattern to complete one repeat of the design, which must occupy an *even* number of

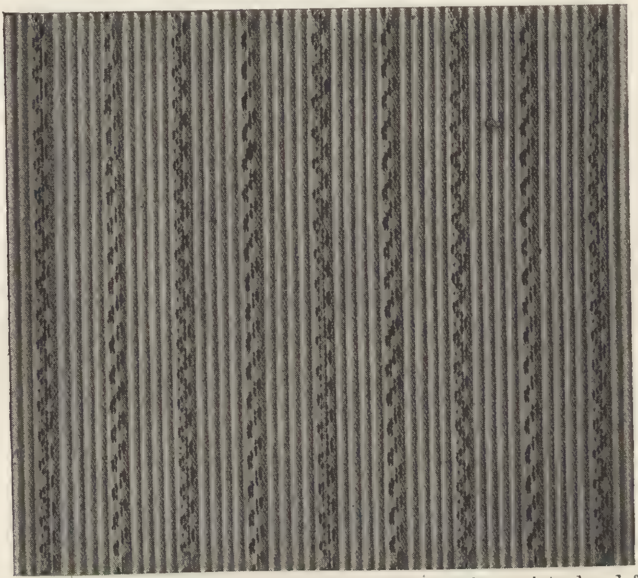


Fig. 295.—Bedford Cord in which Coloured Warp-ends are introduced for embellishment, as indicated by Design Fig. 296.

cords. This circumstance does not prevent figuring threads in each cord from being governed by the same healds. In the present example, the extra figuring threads are governed by four healds, making a total of twelve healds disposed as follows: Four at the front governing extra figuring threads, followed by two governing wadding, two governing cutting, and four in the rear governing face threads. By drawing figuring threads through healds placed in front, they are subjected to less strain due to shedding, since each successive heald from the front

requires to be moved through a greater distance in order to maintain the proper angle of warp shed. Warp ends are contained on three separate warp beams containing figuring, face and wadding threads respectively, with figuring threads lightly tensioned to permit of their being easily withdrawn during weaving. Another example of simple figuring by the employment of extra warp ends is illustrated in Fig. 297, showing the face and back of the same cloth. The extra threads are employed at intervals of eight cords for the development of small spots arranged alternately. To prevent figuring threads from floating too far at the back of cloth, between any two spots, they

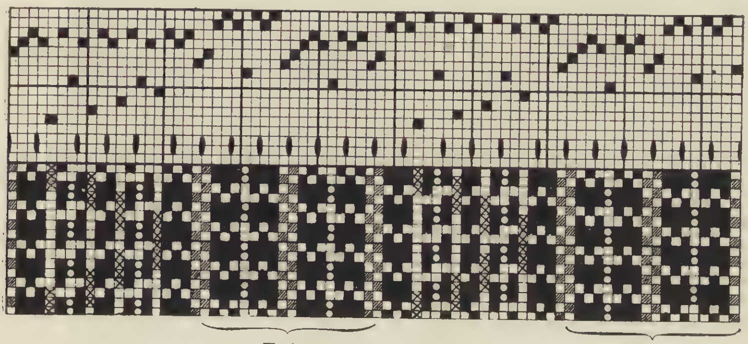


FIG. 296.—Design for Bedford Cord Fabric represented by Fig. 295.

are raised over every twelfth floating pick as indicated in the portion of design (Fig. 298).

Instead of lying at the back of cloth, as in the last two examples, figuring threads may, as an alternative method, lie with wadding threads, between the face of cloth and floating picks at the back; but if face and figuring threads are of contrasting colour, the latter will tend to impart a tinge of their colour to the whole of the cord, as previously stated.

§ 53. Fig. 299 is an example of figured Bedford cord having a simple floating weft figure developed by means of a Jacquard machine. Surrounding the figures is a ground filling of an ordinary plain-ribbed Bedford cord, each rib of which comprises four face, two cutting and two wadding warp ends drawn

through two dents of the reed. *All* warp ends are controlled

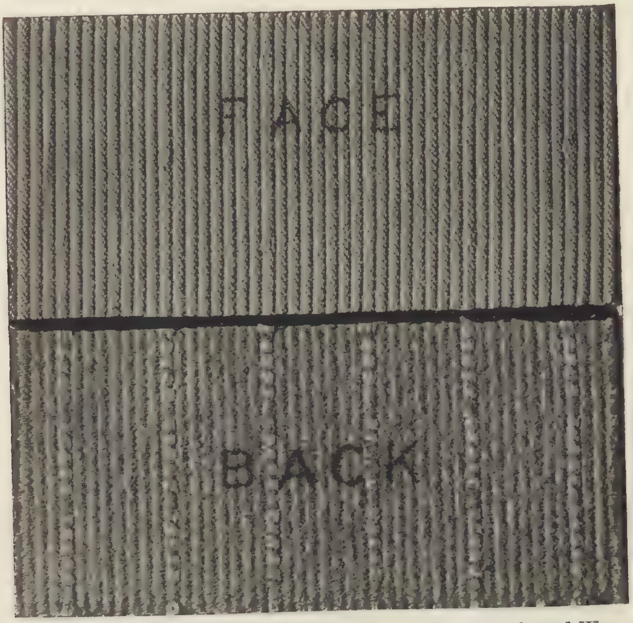


FIG. 297.—Bedford Cord embellished by the introduction of Coloured Warp-ends, as indicated by Design Fig. 298.

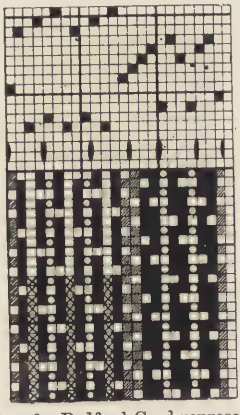


FIG. 298.—Design for Bedford Cord represented by Fig. 297.

by a Jacquard machine, but only face and cutting warp ends are

utilised for the purpose of binding weft floats in the figure portions; whilst wadding threads are kept entirely at the back in those parts. This necessitates an applied design being prepared in two stages as follows: The design is first set out on design paper of the proper counts (according to the ratio of face and cutting threads and picks per inch) without regard to wadding threads, and afterwards transferred to another sheet of design paper on which wadding threads are indicated at their

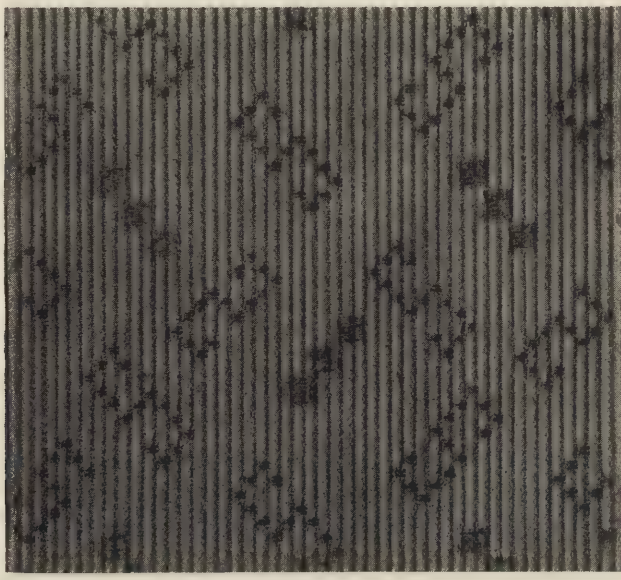


FIG. 299.—Bedford Cord, figured by means of a Jacquard Machine.

proper intervals. In the present case the third and sixth vertical divisions would be marked in each bar of design paper (assuming eight divisions in a bar) corresponding to the third and sixth long rows of hooks in the Jacquard machine.

§ 54. The following table gives data of the manufacture of all examples of Bedford cord fabrics described in the present chapter. The character of warp and weft yarn employed in their production is, in general, normal as regards both amount of twist and quality:—

DATA RELATING TO THE FOREGOING EXAMPLES OF BEDFORD CORDS.

Example.	Dents of Reed per Cord.	Dents per Inch in Reed.	Counts of Face Warp.	Counts of Wadding Warp.	Picks per Inch.	Counts of Weft.	Remarks.
Figs. 277, 282	4	28	40's	7's	96	40's	A low-medium texture of medium quality.
Fig. 278	2	22	20's	—	72	40's	A light open texture for summer wear.
,, 280	2	38	40's	2/40's	112	60's	Ditto ditto
,, 281	2	30	50's	2/30's	132	50's	A medium-weight texture of good quality.
,, 283	3	40	40's	18's	112	40's	A medium-weight texture of medium quality.
,, 284	5	45	40's	20's	140	50's	A heavy and close texture of good quality.
,, 285	7, 3, 3	33	20's	2/12's	92	50's	A medium-weight texture of medium quality.
,, 286	3	38	2/40's	2/20's	140	26's	A heavy and very compact texture of good quality.
,, 288	4	32	40's	4/28's	100	50's	A light texture of medium quality.
,, 289	3	28	30's	—	90	24's	Ditto ditto
,, 290	3	43	40's	2/24's	144	50's	A heavy and compact texture of good quality.
,, 291	6	36	30's	2/24's	144	40's	Ditto ditto
,, 292	5	30	30's	30's	92	16's	A very heavy texture for men's clothing.
Figs. 293–4	7	27	2/16's*, 2/60's†	2/16's	66	2/16's	Ditto ditto
,, 295–6	3, 6‡	40	44's§	2/20's	132	50's	A medium-weight texture of good quality.
,, 297–8	3	40	2/40's‖, 2/48's¶	2/24's	152	24's	A heavy and compact texture of good quality.
Fig. 299	2	28	40's	2/20's	100	40's	A medium-weight texture of good quality.

* Face and back warps. † Cutting warp-ends. ‡ Figured cord. § Face and figuring warps. ‖ Face warp.
¶ Figuring threads (mercerised) drawn through heald eyes in pairs.

CHAPTER VI.

BACKED FABRICS.

§ 55. "Backed" fabrics are characterised by an additional series of either warp or weft threads employed for the purpose of increasing their strength, weight, bulk and warmth, or any one of those properties, without affecting their surface appearance. They are largely produced in worsted textures and fustians intended for boys' and men's clothing, for which purpose they are eminently adapted, as they are capable of yielding firm and compact though soft and warm textures. Backed fabrics occupy a position midway between "simple" textures, which are composed of one series each of warp and weft threads, and "compound" textures, which contain two or more series each of warp and weft, as exemplified in all double cloths. When properly constructed, they bear no indication whatever on their surface, of these additional threads, which lie entirely at the back and are, therefore, completely obscured by the surface texture. The extra series of threads introduced for "backing" may be either of warp or weft, with "face" and "back" threads arranged either alternately or in the proportion of two "face" threads to one "back" thread. If "backing" threads are of weft, it is generally coarser and of inferior quality to that employed for "face" picks, thereby requiring a loom provided with a checking motion for at least two shuttles, and a picking motion that will permit of picking (*i.e.*, propelling a shuttle), twice in succession from either shuttle-box of the loom sley; or in such other manner as is determined by the particular disposition of "face" and "back" picks. If the extra series of "backing" threads are of warp, a loom of ordinary construction without any special device will serve all requirements; also

production will be increased by reason of inserting fewer picks per inch, and a weaver will be paid a lower rate of wages than if employed on a check loom. Against these advantages, however, the extra warp ends will necessitate the use of a greater number of healds, thereby impeding the progress of a weaver when "drawing in" warp ends through healds and reed; also, in some circumstances it may be desirable to wind "backing" warp ends upon a separate beam to permit of the tension of each series of warp ends to be independently regulated to suit their different rates of contraction during weaving.

Whether "backing" threads are of warp or weft, the chief aim of a designer should be directed towards interweaving them with the face texture so as to effectually conceal their attachment when the fabric is viewed obversely. This can only be

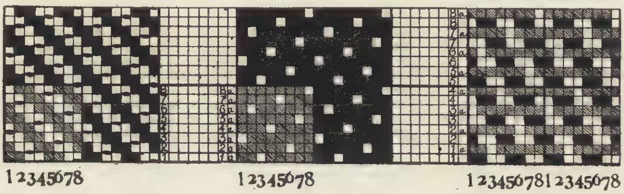


FIG. 300. FIG. 301. FIG. 302.

successfully accomplished when due regard is paid to the character of weave constituting the face texture, which should, so far as is compatible with other requirements, conform to the conditions imposed by this principle of fabric structure. If it is desired to "back" a fabric with extra weft, a design should be selected in which each warp end passes beneath not less than *two contiguous picks* of weft (but with each warp end under different picks) at least once in each repeat of the design. If extra warp ends are to constitute the "backing," the design should be one in which each pick of weft passes beneath not less than *two contiguous warp ends* (but with each pick under different warp ends) at least once in each repeat of the design. By adopting this expedient, suitable places are provided at which to bind or "tie" the extra series of threads to the face texture, so that the "ties" or binding points will be effectually obscured.

These remarks will be easily understood on consulting Figs. 300 to 303.

Fig. 300 is a design for a four-end ($\frac{2}{2}$) twill, to constitute the face weave of a fabric to be "backed" with weft in the proportion of one "face" pick to one "back" pick—the "back" picks to interweave on the eight-end satin basis, Fig. 301. When the two weaves are combined pick and pick, they produce a design repeating on eight warp ends and sixteen picks, as shown in Fig. 302, in which filled squares represent "face" picks, and shaded squares "back" picks. The points selected for binding "back" picks into the face cloth are where a warp end passes beneath two contiguous picks (as indicated in Fig. 300), which by lying close together above those points, entirely obscure the inter-

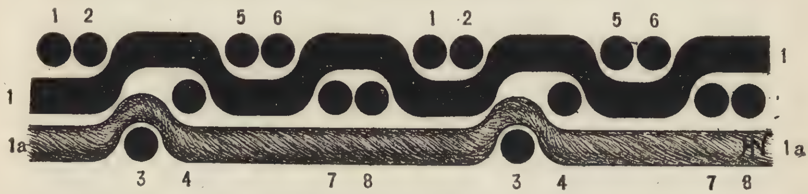


Fig. 303.—Transverse Section of a Weft-backed Fabric woven from Design Fig. 302.

sections from view. It will now be perfectly clear that suitable binding places (in weft-backed fabrics) occur only at such points where the binding thread passes beneath at least *two* contiguous face picks which serve to cover those points, and that if a design is of such character that warp ends pass beneath only one face pick at a time, the binding points are liable to show on the face, in consequence of imperfect covering by face picks. It should be observed that when a back pick is inserted, all warp ends are raised excepting those which are required to pass under it for the purpose of binding it to the fabric, as seen in Figs. 302 and 303.

Fig. 303 represents the "face" and "back" picks (Nos. 1 and 1*a* respectively), of design Fig. 302, as they would appear in cloth when viewed transversely, and shows the "back" pick passing over the third warp end as the latter passes *beneath* the first and second "face" picks which close over and completely cover the binding or "tie".

In order to obtain the best results, all warp ends should, if possible, be utilised for binding "back" picks to the face texture, and binding points should be uniformly distributed; therefore, the nearer such distribution approaches to that of a satin basis the better. Many designs, however, will not permit of the employment of every warp end for binding purposes; nor of the distribution of binding points on a satin basis. In such cases,

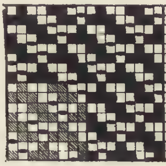


Fig. 304.

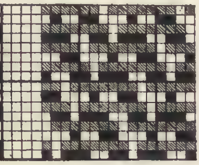


Fig. 305.

a little skill is oftentimes required to make a selection of binding places that will give the best results. Hence the necessity of avoiding such impediments when preparing designs intended for this class of fabrics.

Figs. 304 to 313 are examples of small figured weaves for "backing" with extra weft, and show the face weaves or plans, and completed designs, separately, with the most suitable places

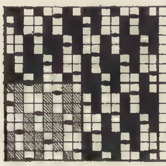


Fig. 306.

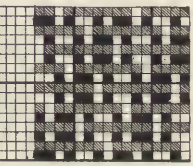


Fig. 307.

for binding "back" picks to the face texture indicated upon each plan. Figs. 304 and 306 have the binding points arranged for an alternate disposition of "face" and "back" picks, as observed in the completed designs, Figs. 305 and 307 respectively. The weave plans shown in Figs. 308, 310 and 312 have the binding places indicated for the picks to be disposed in the order of *two* "face" picks and "one" back pick alternately, as exemplified in their respective completed designs, Figs. 309, 311 and 313.

§ 56. The construction of warp-backed fabrics is governed by the same principles as those which govern the construction of weft-backed fabrics, as regards the method of securing the extra series of threads to the face texture. Therefore, the binding of "back" warp ends must occur at such places as will ensure

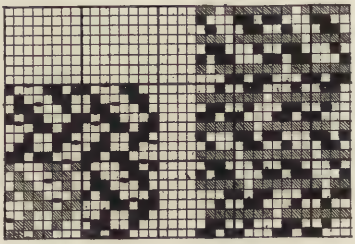


FIG. 308. FIG. 309.

the binding points being properly covered by "face" warp ends. In other words, a "back" warp end should only be raised over a pick when the latter is passing beneath two or more "face" warp ends; otherwise the binding points will be liable to show on the face of the fabric. Fig. 314 represents the face weave of

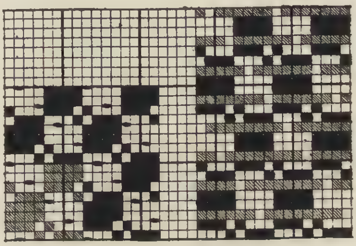


FIG. 310. FIG. 311.

a fabric to be backed with warp on the one-and-one or alternate disposition of threads, with the most suitable binding places indicated on the design, which permits of a distribution of binding points on an eight-end satin basis. Fig. 315 is the same design with "back" warp ends added, and with the heald drafting of warp ends shown above. Fig. 316 is another design for a warp backed fabric with warp ends disposed in the proportion of two

"face" threads and one "back" thread alternately, as shown in the complete design, Fig. 317, with the draft shown above it.

Warp-backed textures are usually constructed with an *alternate* disposition of warp ends to produce a superior back to those constructed on the two "face" and one "back" arrangement of

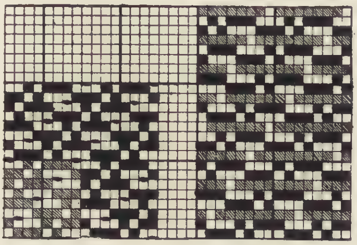


Fig. 312. Fig. 313.

threads. "Back" warp ends usually interweave with weft in a much less degree than do the "face" warp ends, thereby producing a softer back, arising from the greater length of floats. This lesser degree of interlacement of "back" warp ends

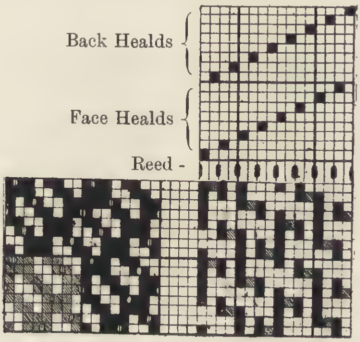


Fig. 314. Fig. 315.
Design for Warp-backed Fabric.

results in a consequent lesser rate of contraction than "face" threads during weaving, thereby requiring each series of warp ends to be contained on separate warp beams to permit of their independent regulation for tension. "Back" warp ends should be drawn through a set of healds apart from those governing "face" threads, and should preferably be placed in the rear of

face healds, as indicated in the drafts above Figs. 315 and 317. Also, "back" warp ends should pass from the warp beam to healds in a slightly *lower* plane than "face" threads, and should not be raised quite so high as the latter during shedding. By observing these precautions, unnecessary abrasive friction and chafing of warp ends will be avoided, and any tendency of binding points to show on the face is thereby reduced.

§ 57. Another variety of backed fabrics, constructed on exactly the same principles as the previous examples, are known also as reversibles or double-faced fabrics, from the fact that it

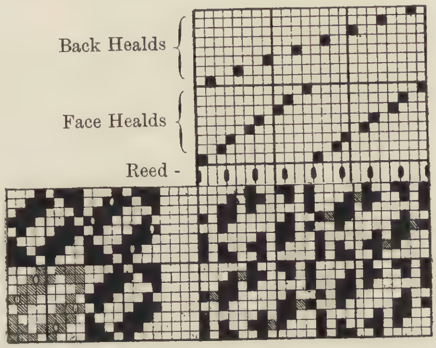


FIG. 316. FIG. 317.
Design for Warp-backed Fabric.

is quite optional which side is exposed to wear. Reversible fabrics are exemplified in some ribbons (which usually have both sides equally exposed when in wear), shawls, travelling rugs, mantle cloths, coatings, and some fustians, which may be made to present a similar appearance on both sides; or each side may be different both in respect of weave and colouring. This opportunity is often seized upon to provide mantle cloths and coatings with self-linings of quite a different character in both colouring and texture to the face or outer texture, albeit the lining forms an integral part of the fabric, which is thereby rendered heavier, thicker and warmer.

CHAPTER VII.

FUSTIANS.

§ 58. Fustians are a well-known type of cotton fabrics comprising several varieties, the chief of which are known as "imperial," "swansdown," "cantoon" or "diagonal," "moleskin," "beaverteen," "velveteen" or cotton velvet formed with a weft pile, and "corduroy". With the exception of velveteens, which simulate the real silk velvet formed with a warp pile, they are comparatively firm, heavy and compact textures of great strength and durability, chiefly employed in the production of clothing. The first three varieties embody no special constructive feature in their design, as they are based on some simple weave that permits of an abnormally high rate of picks being inserted so as to produce a compact fabric. Each of the remaining varieties, however, is characterised by some peculiar constructive element that distinguishes it from all other fabrics. These are virtually "backed" fabrics, since they are constructed with one series of warp ends and two series of weft, namely, face and back, although both series of picks are of the same kind of weft, thereby requiring a loom with only one shuttle-box at each end of the sley, to produce them.

Unlike all other varieties of fustians, velveteens and corduroys are characterised by a short and soft fur, closely resembling that of silk velvet. This fur-like effect is obtained subsequent to weaving by a process known as "fustian cutting," in which certain floating picks of weft are cut or severed by specially constructed knives, either manually or mechanically, thereby causing those picks to become more or less vertical to their foundation, and to

expose their transverse sections to the surface, which gradually assumes the character of true velvet. In plain velveteens, a pile of uniform length is uniformly distributed over the fabric, thereby forming a perfectly level surface ; but in corduroys, the pile is caused to develop a ribbed or corded formation, with the cords produced lengthwise or parallel with warp ends. These characteristics are clearly illustrated by Figs. 318 and 319, which

Fig. 318.—Velveteen (Cotton Velvet), before and after the operation of Fustian Cutting.

are reproduced from actual examples of velveteen and corduroy respectively. Each example shows a portion of cloth both before and after the operation of cutting. It should be observed, however, that velveteens are sometimes made to assume a corded appearance resembling that of corduroys ; but their different texture and construction enable them to be easily distinguished from the latter when the characteristics of each are known.

Imperials.

§ 59. The variety of fustians known to the trade as "imperials" comprises several modifications of what is perhaps better known as "swansdown" cloth, so called from the soft nap or downy surface produced, after weaving, by scratching up or raising the fibres composing the threads of weft by an

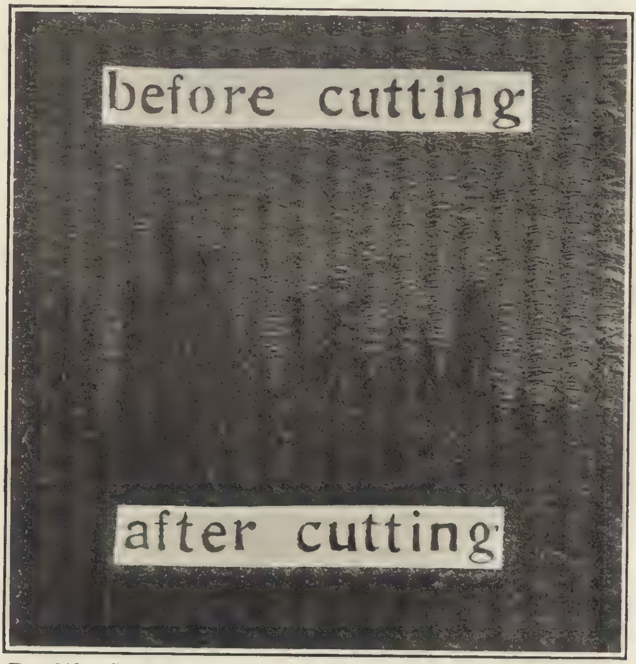


FIG. 319.—Corduroy, before and after the operation of Fustian Cutting.

operation termed "perching". The nap thus formed resembles the soft down of swans (hence its name) and greatly increases the warming properties of the fabric. For this reason it is largely employed as ladies' underclothing. Fig. 320 is a design for swansdown repeating on five warp ends and five picks. From the design, it would appear that weft preponderates on the face in the ratio of three of weft to two of warp; but, virtually, it gives an all-weft surface by reason of the much greater

density of picks, as compared with warp ends, which latter are entirely obscured on the face. Also, to facilitate the development of a nap by perching, a fairly soft weft of good quality is used. A good quality of swansdown contains 60 warp ends of 18's T., and 120 picks of 20's soft weft per inch.

A heavier make of swansdown, known as "imperial sateen," is produced from the design Fig. 321, repeating on eight warp ends and picks, and based on an eight-end satin weave, but with two contiguous warp ends always raised together. This weave produces relatively longer floats of weft, which latter preponderates over warp in the ratio of six to two respectively. Imperial sateens are sometimes dyed and finished to imitate light moleskins, with a short nap raised on the *back;* but when imperials

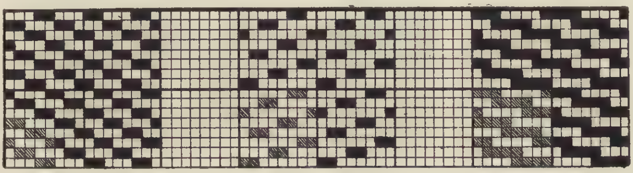


FIG. 320.—Design for "Swansdown" Cloth.

FIG. 321.—Design for "Imperial Sateen" and "Lambskin" Cloth.

FIG. 322.—Design for Reversible Sateen Cloth.

are perched on the face they are named "lambskins," from their long soft woolly nap. A medium quality of dyed imperial sateen contains sixty-eight warp ends of 16's T. and 150 picks of 16's weft per inch; whilst a good quality of "lambskin" contains forty-six warp ends of 2/20's warp, and 450 picks of 20's weft per inch. A design for what is termed a reversible "imperial" contained on eight warp ends and picks is given in Fig. 322. By densely crowding picks of weft, this weave produces a very compact texture, with only weft visible on both surfaces of cloth. A good quality of this cloth contains sixty-two warp ends of 14's T. and 330 picks of 30's weft per inch.

"Cantoons" or "Diagonals".

§ 60. Cantoon is a variety of fustian largely employed in the production of men's riding and sporting suits, and occasionally

of ladies' jackets. As with the previous examples of fustians, its construction embodies no special feature of design, but merely consists of a pick-and-pick combination of the two regular six-end twill weaves, Figs. 323 and 324, to produce the design Fig. 325, which repeats on six warp ends and twelve picks. A good example of this cloth under present notice contains fifty-four warp ends of 2/20's warp, and 400 picks of 20's weft per inch. This abnormal density of picks produces a very strong and compact fabric having a fine corded appearance, with the cords or wales running obliquely at an angle of 18° to the picks of weft. These fabrics are usually dyed either a fawn or drab hue, and perched on the back.

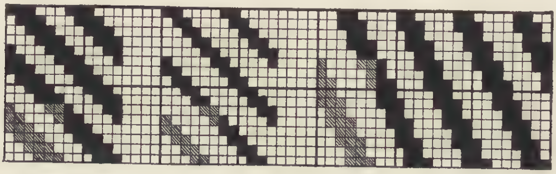


Fig. 323. Fig. 324. Fig. 325. Design for "Cantoon" or "Diagonal" Cloth.

Moleskins.

§ 61. Moleskin is a smooth but thick leathery variety of fustian of greater strength and weight than other varieties, and is largely employed in the production of strong suits of clothing for iron and brass-moulders, navvies and other workmen engaged in rough occupations. Its thickness and compactness of texture, combined with its smooth and even surface, make it well adapted for moulders, as it is impervious to sand, and not so easily penetrated as other fabrics by splashes of molten metal. Moleskins are produced from one series of warp ends and two series of picks (of the same kind of weft), namely, face and back picks, inserted in the proportion of two face picks to one back pick. Face picks combine with alternate warp ends only, to produce a modified satin weave repeating on six warp ends and three picks; whilst back picks interweave with all

warp ends to produce a three-end weft twill at the back, as indicated in design Fig. 326, which repeats on six warp ends and nine picks. By causing only alternate warp ends to bind over face picks, in addition to combining with back picks, there is a slight tendency to impart a little more strain upon those threads than upon intermediate threads which combine with back picks only. The additional strain upon those warp ends tends to develop a faint stripy formation in cloth, which is, however, considered to be a point of excellence.

Moleskins permit of little or no structural modification without departing from their true character. The moleskin design given in Fig. 327 shows a slight departure from the previous example, but one that would manifest no appreciable difference

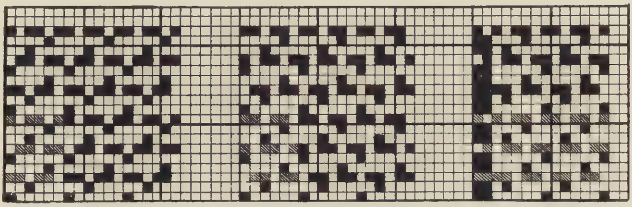


Fig. 326. Fig. 327. Fig. 328.
Designs for Moleskin Fabrics.

in cloth, excepting to an experienced person. In Fig. 326 it will be seen that at certain points alternate warp ends pass abruptly from above a face pick and underneath a back pick, whereas in Fig. 327 there is always an interval of one pick between the bindings of a face and a back pick by the same warp end. For example, in Fig. 326 the third warp end is over the second face pick and under the following, which is a back pick. The passage of warp ends over a face pick and then immediately under a back pick increases their tension and thereby tends to slightly emphasise the stripy appearance just mentioned.

Moleskins are not well adapted to decorative treatment of a structural character, but they, as well as heavy imperials, are sometimes printed with simple decorative effects to imitate worsted suitings, and employed in the production of men's clothing. They are also sometimes woven with a simple stripe

formation, as exemplified by the design, Fig. 328, which repeats on fourteen warp ends and nine picks. A moleskin fabric of good quality contains thirty-eight warp ends of 3/24's warp, and 400 picks of 14's weft per inch.

Beaverteens.

§ 62. Beaverteens are virtually moleskins produced in lighter textures, that are afterwards dyed and printed and then perched on the back, to produce a short and soft nap. Fig. 329 is a design for a beaverteen contained on six warp ends and twelve picks, with three face picks to one back pick. The face weave is almost similar to the swansdown weave given in Fig. 320, and the back is a plain but not a true calico or tabby weave. All

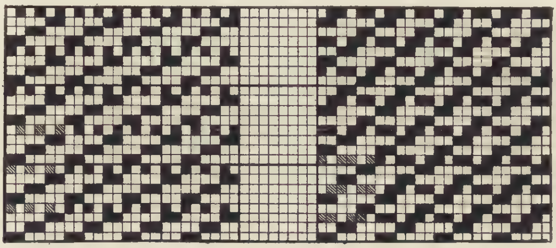


Fig. 329. Fig. 330.
Designs for Beaverteen Fabrics.

back picks interweave under and over consecutive warp ends, as in the plain calico weave; but alternate warp ends are raised for two out of three back picks, and intermediate warp ends weave in an opposite manner to those, namely, down for two picks and up for one. Fig. 330 is another design for beaverteen, contained on six warp ends and nine picks. It has the same face weave as the previous example, but is backed with three-end weft twill and contains only two face picks to one back pick. A good quality of beaverteen contains thirty-two warp ends of 2/18's warp and 280 picks of 18's weft per inch.

Velveteens.

§ 63. Velveteens constitute an important variety of fustians, generally of much lighter texture than other varieties. As pre-

viously stated in § 58, their characteristic velvet appearance is produced subsequent to weaving, by an operation of fustian cutting (performed sometimes by machinery for low qualities only, but more frequently by hand) which is usually conducted independently as a kindred branch of fustian manufacturing. Previous to being cut, a velveteen presents no unusual structural appearance, but has a smooth level surface with weft floating abundantly on the face, as if it were constructed on a simple satin basis.

Velveteens are produced from one kind of weft inserted so as to constitute two series of picks, namely "pile" and "ground" picks, corresponding to face and back picks respectively. Pile picks are floated somewhat loosely on the surface, to be afterwards cut to form pile; whilst ground picks interweave more frequently with warp, to build up a firm foundation texture to sustain the pile. Indeed, the simplest definition of a velveteen fabric is: A simple texture of calico, twill or other simple weave, embodying a vast number of short tufts of weft (thus—U) evenly distributed to produce a soft velvet-pile surface. Thus, if all the tufts of pile were entirely withdrawn, there would still remain a perfect foundation texture of a plain, twill or other simple weave according to the basis adopted. For light and medium textures, the latter is usually based on either the tabby or three-end twill weave; and for heavier textures, on the four-end ($\frac{2}{2}$) twill weave.

It is important that pile picks should be securely attached to the foundation texture to prevent the tufts of pile being accidentally withdrawn either during fustian cutting or when the fabric is in use. This may be accomplished in two ways, namely (*a*) by compression, caused by densely crowding picks of weft; and (*b*) by interweaving pile picks with several warp ends in succession, to produce what is termed a "fast" or "lashed" pile; or by adopting both of these methods. Most velveteens, however, are constructed on the former plan, in which pile picks are bound into the foundation texture by only one warp end at regular intervals of six, eight or ten threads according to length of pile required. The second plan is usually adopted when it is required to float pile picks for a greater distance, for the purpose of producing longer pile, the tufts of which would be more liable to accidental withdrawal. Whether pile picks are bound by only one or

more than one warp end in each repeat of the pattern, it is imperative that the binding should occur at regular intervals on each pick, to give uniform lengths of floats, and therefore, a uniform length of pile after cutting.

§ 64. Fig. 331A is a simple design, repeating on six warp ends and six picks, for a tabby back velveteen containing two pile

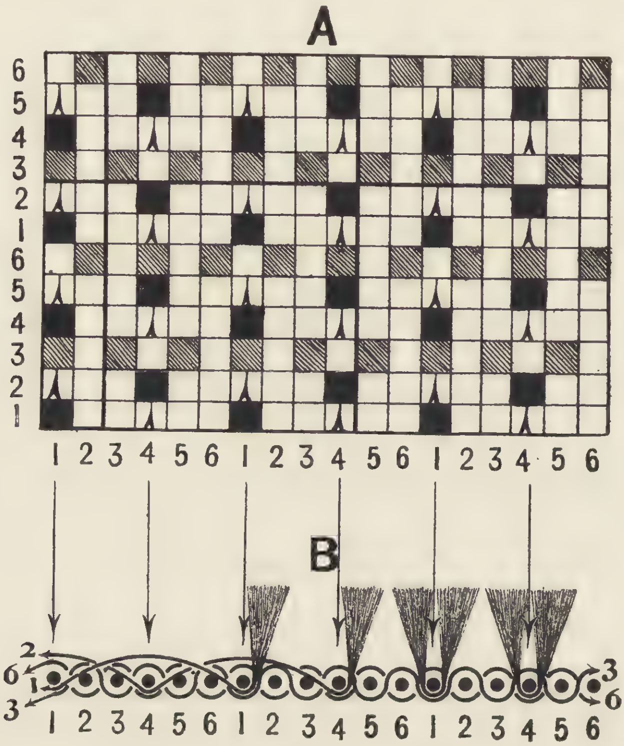


FIG. 331.—(A) Design for Velveteen Fabric, of which B is a graphic representation of a Transverse Section, showing some Picks of Weft standing erect, after being severed by the Fustian Knife to form tufts of Pile.

picks to one ground pick, with pile picks bound at intervals of six, to cause them to float over five, warp ends. In this example, every third warp end only is utilised for binding pile picks to the ground texture, namely, the first and fourth in each repeat of the pattern; whilst all warp ends interweave with ground

picks to produce the foundation texture. This combination of threads causes the floats of pile picks to develop a series of courses or passages running lengthwise, termed "races," which lie above the ground cloth and along each of which a fustian cutter passes the fustian knife, so that the cutting edge of the latter passes under all floats of weft forming a "race," thereby severing them in the centre and causing them to become erect on each side of a binding thread to produce the characteristic short tufts of pile. This is clearly illustrated in Fig. 331B, which represents a transverse section of cloth (produced from the design above it), both before and after cutting. The paths along which the fustian knife takes its course, and also the points at which pile picks are severed, occur at intervals of three warp ends, as indicated by arrows.

§ 65. A fustian knife for cutting by hand is illustrated in Fig. 332. It consists of a square steel rod A, beaten out at one end to form an extremely thin keen-edged blade B, and is provided with a handle C at the other end. The knife blade is inserted in a shaped and pointed sheath D, of sheet iron or steel, which serves the threefold purpose of (a) giving firmness to the slender blade;

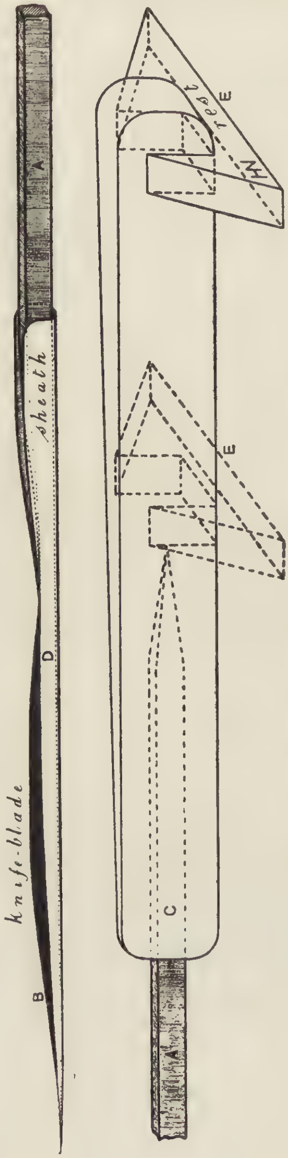


Fig. 332.—Fustian Knife for Cutting by Hand.

(*b*) guiding the blade along its true course under the proper floats; and (*c*) tautening the floats of weft as it passes under and brings them up to the exposed edge of the knife, to be severed. Fustian knives are made in various lengths from about 12 in. to 30 in. from steel rods varying from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. square, and each is provided with a sheath or guide specially shaped and pointed to suit the particular kind of cloth for which it is intended (as velveteen or corduroy), and also the width of "race". A fustian knife handle is sometimes furnished with a piece of wood E, to serve as a rest for the knife, and maintain it at the proper angle as it traverses a "race". The rest E is fixed at the rear end of the haft when cutting velveteen on a "short-run" frame (of two yards in length), and in the centre of the haft (as indicated by dotted lines) when cutting corduroy.

§ 66. Before being submitted to the operation of fustian cutting, velveteens are first subjected to a process of liming, in which a thin coating of lime paste is applied to the face side of cloth by passing it over a roller revolving in slaked lime. From the lime trough the cloth is immediately passed over a number of steam-heated cylinders to be dried; after which it is coated on the back with flour paste and again dried for the purpose of stiffening it and to prevent the withdrawal of tufts of pile during cutting. After this preparation, the cloth is made taut by stretching in a suitable frame of either two or about ten yards in length, when the cutter passes a knife smartly along successive "races," taking each in turn from one selvedge to the other. Subsequent lengths of cloth are then stretched and cut in a similar manner until the whole piece is completed, after which it is submitted to various finishing processes. The operation of cutting velveteen by hand on short frames is illustrated in Fig. 333,[1] in which fustian cutters are shown standing at the side of their frames; but when cutting corduroy on a short frame the cutter stands at one end.

The foregoing description of a simple example of velveteen, and of fustian cutting, will enable a student to intelligently

[1] The author is indebted to Messrs. Henry Bannerman & Sons, Limited, for their kind permission to use this illustration.

FIG. 333.—Cutting Velveteen by Hand (Short Frame).

comprehend some of the circumstances affecting the production of velveteens and corduroys, and thereby to better conform to the conditions which their construction imposes upon a designer, namely, the proper security of pile to the foundation texture, and the distribution of binding places in such manner as to provide suitable "races" or passages at regular intervals for the reception of the fustian knife.

§ 67. Fig. 334 is a design in extensive use for a tabby-back velveteen repeating on six warp ends and eight picks, having three pile picks to one ground pick, with consecutive pile picks bound by alternate warp ends at intervals of six threads. It

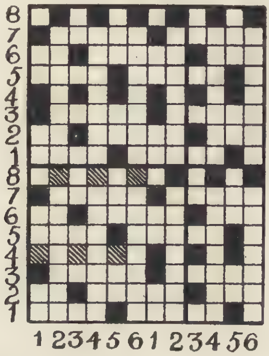


FIG. 334.—Design for Velveteen Fabric.

will be observed that pile picks are bound by the same alternate warp ends that are raised for the first ground pick in each repeat of the pattern; whilst the intermediate threads are only raised for the second ground pick, thereby causing the three pile picks between each ground pick to become equivalent to, and subsequently occupy the space of, only one pick of weft. Hence, the eight picks constituting one repeat of the design are equivalent to only four picks when in cloth.

The employment of *alternate* instead of consecutive warp ends for the purpose of binding pile picks is a practice which, for several reasons, is adopted in the construction of velveteens. In the first place, it reduces the number of "races" by one-half, by creating them along alternate warp ends only, instead of

along all warp ends, thereby requiring less time for cutting and reducing the cost of that operation. In the second place it facilitates the operation of cutting by developing more clearly defined "races" for the reception of a fustian knife. And, finally, by causing tufts of pile to lie along alternate warp ends, instead of being distributed on all warp ends, a more perfect simulation of real velvet is produced, and one that makes the difference between velvet and velveteen sometimes very difficult to detect.

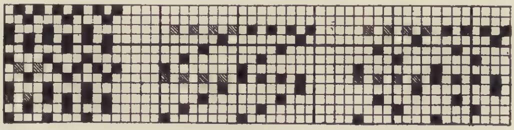


FIG. 335. FIG. 336. FIG. 337.

The use of alternate threads of the same warp to bind over face picks as well as under back picks tends (as explained under the heads of backed fabrics and moleskins, in §§ 56 and 61) to impart a little greater strain upon those threads; but in consequence of the sparseness of warp ends, and the considerable degree of tension at which they are held during the weaving of fustians, the difference in tension between binding and non-binding threads is so small as to develop only the faintest

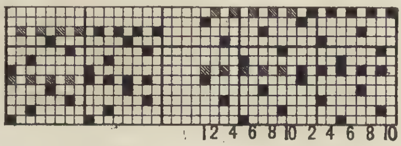


FIG. 338. FIG. 339.

stripiness in the uncut cloth, which entirely disappears after cutting; nor is the difference in tension such as to necessitate the binding and non-binding warp ends being wound upon separate warp beams. This is explained by the circumstance of warp ends being held so taut during weaving that the softer, finer and more supple weft exerts little or no influence upon them, and so they remain perfectly straight.

§ 68. Figs. 335 to 364 are examples of designs showing various modifications in the construction of velveteen fabrics.

A cursory examination will show that the essential points of difference in them are in respect of their foundation weaves, and the method of securing pile picks thereto. Other points of difference, not of a structural character, are the ratio of pile picks to ground picks, and the length of float between the binding points of pile picks. Fig. 335 is a design for a tabby-back velveteen containing two pile picks to one ground pick, with pile

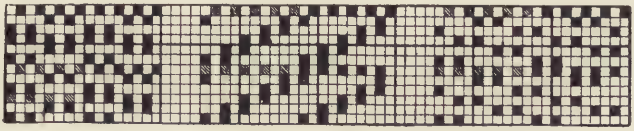


FIG. 340. FIG. 341.—Represented in Transverse Section by Fig. 344. FIG. 342.—Represented in Transverse Section by Fig. 345.

weft floating over only three warp ends between each intersection, which would produce an exceedingly short and poor pile. Figs. 336, 337 and 338 are three designs for tabby-back velveteens, each containing four pile picks to one ground pick, with pile weft floating over seven warp ends. Although pile picks are bound in a different order in each design, they would

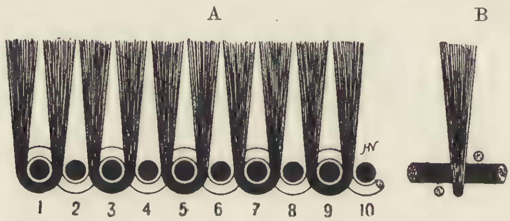


FIG. 343.—(A) Transverse Section showing Ordinary Method of securing Tufts of Pile to the Foundation Texture, in Velveteen Fabrics.

produce absolutely identical results in the finished fabric ; as the four pile picks between two ground picks in each design would constitute only one row of tufts disposed on alternate warp ends. Fig. 339 is a design for a tabby-back velveteen containing five pile picks to one ground pick, with pile picks floating over nine warp ends to produce longer pile.

§ 69. Figs. 340, 341 and 342 are three examples of designs for tabby-back velveteens with a "fast" or "lashed" pile, so

called because the tufts of pile are more securely attached to the foundation texture; thus, instead of being looped under and held by only one warp end, as in previous examples and as illustrated in Fig. 343, each tuft of pile is secured by interlacing with three consecutive warp ends, as shown in Figs. 344 and 345. Although the binding of pile picks in Figs. 341 and 342 is

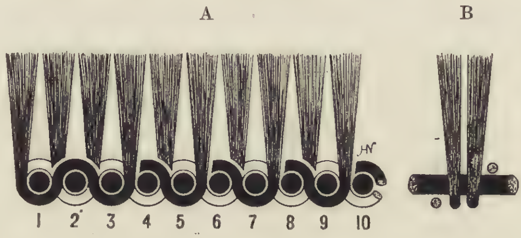


FIG. 344.—(A) Transverse Section of Velveteen, woven from Design Fig. 341, with Fast or Lashed Pile.

of a different arrangement in each, they will produce no material difference in their ultimate results, as seen by comparison of Figs. 344 A, and 345 A, which represent transverse sections of cloth produced from designs Figs. 341 and 342 respectively. In both examples, warp ends are raised over two out of the five pile picks between two ground picks, so that the five pile picks will

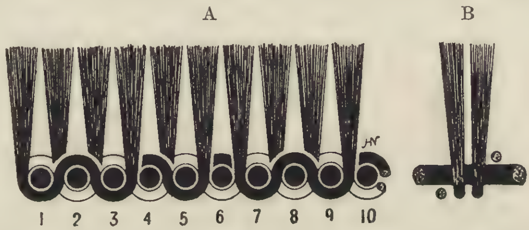


FIG. 345.—(A) Transverse Section of Velveteen, woven from Design Fig. 342, with Fast or Lashed Pile.

occupy the space of *two* picks in cloth (as seen in end views of sections at B). Hence, five tufts of pile will be formed over an interval of ten warp ends, from what virtually constitutes *two* picks of weft (whereas, by the method of binding shown in Fig. 343, five tufts of pile would be formed in the same interval, and from the same number of picks, which would virtually constitute only *one* pick of weft (as seen in end view of section at B) and

which would result, for example, from the design Fig. 339. It is evident, therefore, that a "fast" pile can only be obtained in fabrics of similar quality by sacrificing the density of tufts of pile.

§ 70. It may be observed at this juncture that the relative density of pile in fabrics of similar quality may only be in-

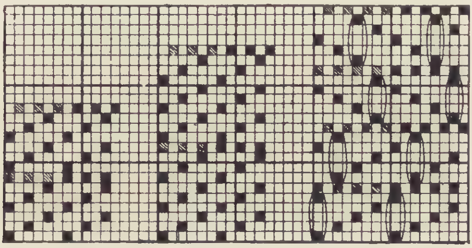


Fig. 346. Fig. 347. Fig. 348.

creased by additional rows of tufts between ground picks. Thus, instead of warp ends binding over only one pile pick between two ground picks to produce only one row of tufts (as in all previous examples), they may bind over two or three pile picks to produce a corresponding number of rows of tufts between two

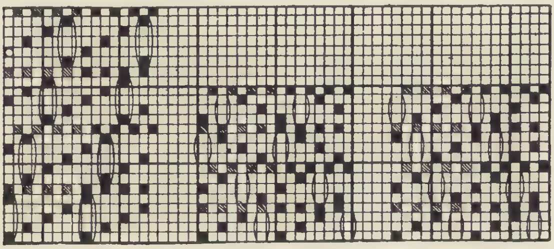


Fig. 349. Fig. 350. Fig. 351.

ground picks, as exemplified in Figs. 346 and 347. Also, each binding warp end should preferably contain the same number of tufts between ground picks to ensure a more perfect distribution of pile; though this precept is not always observed in practice, as will be seen presently. Density of pile is sometimes slightly increased by causing additional tufts of pile to occur in certain

places only, between two ground picks. Conversely, density of pile may be slightly diminished by *omitting* tufts of pile in a similar order. In either case, care should be taken to dispose the additional tufts (or the spaces where they are omitted) so that they will not tend to develop lines in any direction in the finished fabric. Any such tendency is avoided in an ingenious manner in Figs. 348 and 350, which are designed to increase and diminish the density of pile respectively. In Fig. 348 the successive binding points on pile picks are produced in an opposite direction at intervals of two ground picks, thereby disposing the additional tufts of pile in the four-end satin order (as indicated by bracketed squares). Had the successive binding

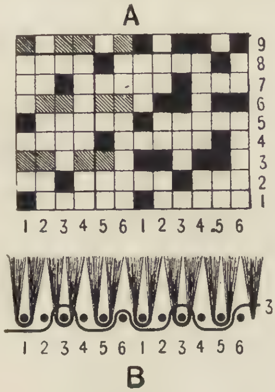


Fig. 352.

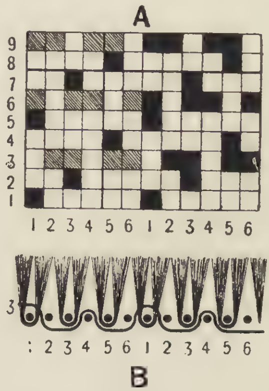


Fig. 353.

points been produced in the same direction throughout, as in Fig. 349, the regular occurrence of the extra tufts would tend to develop a series of lines running obliquely across the fabric. In Fig. 350, which will give a less dense pile, the same practice has been observed of reversing the direction in which binding points are produced at intervals of two ground picks, so as to dispose the gaps (caused by missing tufts, as indicated by bracketed squares) in a four-end satin order, for reasons just explained. Had the binding points in that design been produced in the same direction throughout (as indicated in Fig. 351), the vacant places would, in consequence of their regular succession, tend to develop oblique lines across the fabric.

§ 71. Figs. 352 to 358 are designs for velveteens of a little heavier texture than the tabby-backed variety. Their foundation texture is based on the three-end twill weave, which permits of a greater number of picks per inch being inserted to produce a more compact fabric. In other respects their construction is similar to the previous examples. Apart from the object of increasing weight, a greater degree of compactness in twill-backed velveteens is essential to hold the pile firmly; otherwise the freer character of the weave would produce a more open texture, and thereby permit of the easier withdrawal of tufts of pile. It is sometimes advocated that, when constructing twill-backed velveteens, warp bindings on pile picks that immediately either precede or succeed a ground pick should be placed counter to a weft binding on that pick, so that such warp and weft

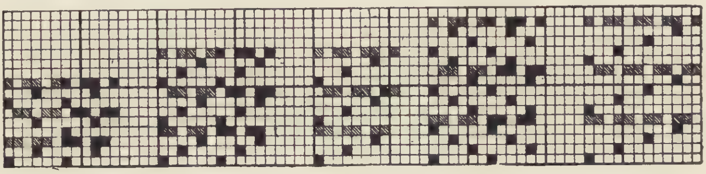


FIG. 354. FIG. 355. FIG. 356. FIG. 357. FIG. 358.

binding points will lock or check each other, and thus give additional firmness to the fabric. A little reflection, however, will show that whilst such precaution would conduce to better results if the weft were not to be subsequently cut to form pile, it is unnecessary to observe it in the construction of velveteen in which the several picks between two ground picks virtually occupy the space of only one pick, or sometimes two picks, in the finished fabric. It may also be pointed out that, whether the warp and weft bindings are or are not placed counter to each other in the design, they automatically become so in the finished fabric; so that precisely similar results accrue whichever practice is adopted. This is clearly demonstrated by means of diagrams Figs. 352B and 353B, representing transverse sections of cloth (after cutting) woven from designs Figs. 352A and 353A respectively, which designs are identical, excepting that warp bindings on every second pile pick in Fig. 352A are placed counter to

weft bindings of the contiguous ground pick; whereas the binding points are not so placed in Fig. 353A, yet their transverse sections are virtually alike. (It will be observed that these two designs are identical with the moleskin designs, Figs. 326 and 327, respectively.) Figs. 354 to 358 are other examples of designs for velveteens with three-end twill backs, showing various modifications; whilst Figs. 359 to 364 are for velveteens having

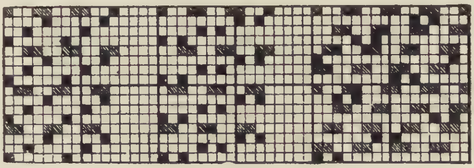


Fig. 359. Fig. 360. Fig. 361.

a foundation texture based on the two-and-two twill, and other weaves, to produce still heavier textures.

Weft plushes are simply velveteens in which pile weft is allowed to float over a considerable number of warp ends to produce a longer pile, the tufts of which are more firmly interlaced by interweaving them under and over three or five con-

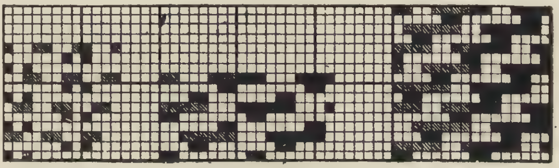


Fig. 362. Fig. 363. Fig. 364.

secutive warp ends, as described in § 69. In other respects their construction is similar to that of ordinary velveteen having short pile.

Ribbed or Corded Velveteen.

§ 72. Velveteen is sometimes made to assume a ribbed or corded formation, resembling that of corduroys, with the ribs or cords produced lengthwise or parallel with warp. There are

so-called "velvet cords" that are not velveteens, but simply

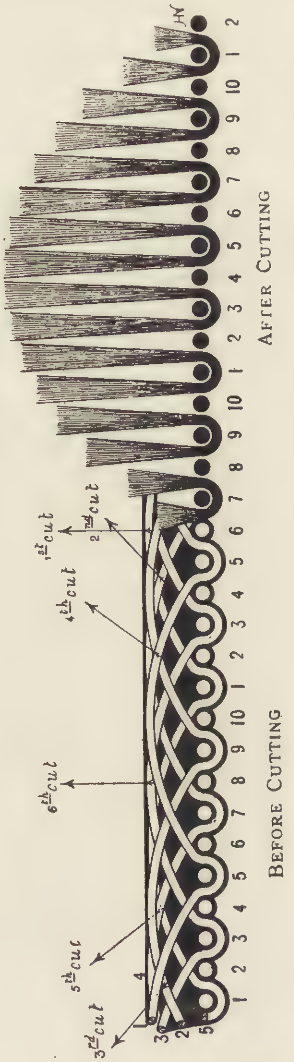


Fig. 365.—Graphic Diagram demonstrating a special mode of Fustian Cutting, to develop a series of Ribs or Cords upon Velveteen Fabrics of ordinary construction, in the production of Ribbed or "Hollow-cut" Velveteens.

light textures of corduroy, which will be described under that head. So-called "ribbed velvet" or ribbed velveteen (also known

as "hollow-cut" velveteen), however, is woven as ordinary plain velveteen, and afterwards made to assume a corded appearance by a special mode of fustian cutting, in which a cutter first passes a knife along certain "races" in each cord, with the blade vertical, as in ordinary cutting, and then along intermediate "races," with the knife blade held at different angles, to sever floats of weft out of the centre, and so form longer and shorter tufts which develop rounded ribs of pile. For some "races" the knife is inclined *towards* the cutter, and for others away *from* the cutter; hence the terms "*towart*" and "*frowart*" used amongst that class of fustian cutters, whose work is regarded as specially skilful. An example of ribbed velveteen under present notice is produced from the design shown in Fig. 339, containing five pile picks to one ground pick, and with pile weft floating over nine warp ends. A transverse section of this cloth (before and after cutting) is represented in Fig. 365, in which arrows indicate the various angles at which the knife blade is held as it is passed along the different "races". The width of cords is not regulated by the number of warp ends on which the woven design repeats, but is arbitrarily decided by the fustian cutter, who may produce various widths of cords from exactly similar fabrics. In the present example the ribs occur at intervals of sixteen warp ends, although the woven design repeats on only ten warp ends. The same fabric could have been cut to produce broader or narrower ribs, as desired.

Figured Velveteen.

§ 73. The embellishment of velveteens is not confined to that created by a simple ribbed or corded formation. They are frequently rendered of a more or less ornate character by means of designs printed in various colours, embossed designs, and designs produced by Jacquard machines. Many woven designs are of a somewhat elaborate character, as exemplified in the specimen reproduced in Fig. 366.

The construction of Jacquard-figured velveteen is governed by the same principles as those regulating the construction of simple velveteen, so far as the development of pile in the figure

portion is concerned; but in the ground portion of the pattern, which is without pile, some method must be adopted to effectually obscure pile weft from the face of the fabric. Various methods are employed to achieve that object. By one—perhaps the most generally satisfactory—when pile picks are not required on the face for the development of figure, they are placed at the back in the ground portion, and interwoven with binding warp

FIG. 366.—Velveteen figured by means of a Jacquard Machine.

ends in an exactly opposite manner to that which obtains in the figure portion. By another method (of which the specimen illustrated is an example), surplus pile weft is allowed to float quite freely beneath the ground portion, and after the operation of cutting, it is brushed off as waste material. A third practice is to employ an extra fine warp to loosely interweave with surplus pile weft at the back of cloth for the purpose of producing a light gauzy and imperfect tissue, which, after the operation of

cutting, is drawn bodily away from the principal texture, thereby removing all surplus pile weft. This precaution, however, is only necessary for designs containing comparatively large areas of ground filling, in which case the resulting masses of floating weft at the back would be liable to be caught and pulled both during and subsequent to weaving, thereby involving risk of injury to the fabric and impeding the operation of cutting.

§ 74. When preparing an applied or working design for a figured velveteen fabric, it must be first drawn to the required dimensions on the proper counts of squared or point paper, and painted in *en bloc*, as in Fig. 367. It may then be transposed

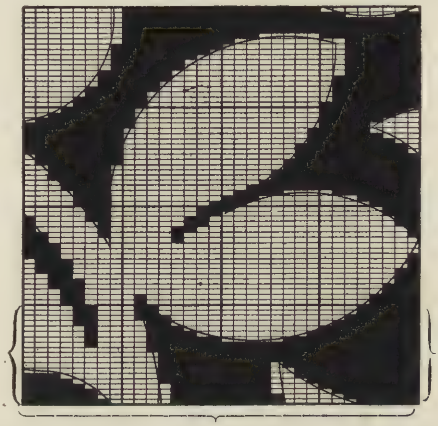


FIG. 367.—Block Sketch-design for Figured Velveteen.

to any other counts of point paper to be read off by the card cutter. The proper counts of design paper for the block design is determined according to the number of rows of tufts to be contained in one inch, both horizontally and vertically, because the margin of figure steps in intervals of tufts of pile each way; thus each small square of the block design corresponds to one tuft. If, therefore, a design is to be prepared for a fabric containing 88 warp ends and 420 picks per inch, with pile weft bound by alternate warp ends, and having three pile picks (which constitute only one row of tufts) to one ground pick (as in the present example) the proper counts of point paper for the

block design is in the ratio of ($88 \div 2 = 44$) to ($420 \div 4 = 105$); or (assuming a Jacquard machine has eight long rows of hooks) the point paper should contain eight squares by nineteen squares in each bar. If a fabric contains four pile picks, constituting only one row of tufts, between two ground picks, the number of horizontal rows of tufts per inch will be one-fifth of the actual number of picks inserted. Again, if a fabric contains six pile picks constituting *two* rows of tufts between two ground picks, the number of horizontal rows of tufts per inch will be two-sevenths of the actual number of picks inserted, and so on.

It is necessary to prepare the pattern *en bloc* on the proper counts of design paper in order to ensure that the correct forms

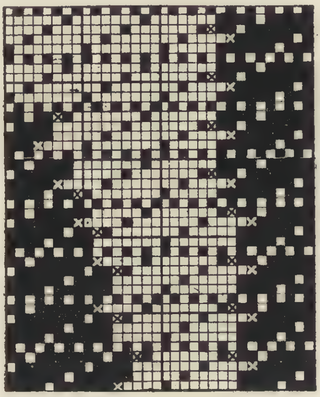


FIG. 368.—Part of Sketch, Fig. 367, prepared as an Applied Design for Figured Velveteen.

and shapes of its component parts will be preserved when reproduced in cloth; but the counts of paper employed for the working design, and from which pattern cards are read off by the card-cutter, is quite immaterial. When preparing an applied design from a block pattern, it must be remembered that all warp ends are controlled by a Jacquard machine, and that a pattern card is required for each pick of weft inserted. Therefore, since each small square of the block pattern corresponds to one tuft of pile, each vertical space on the former represents two, three or four spaces on the working design (according as tufts of pile are

contained on alternate warp ends, or on every third or fourth warp end), and each horizontal space in the block pattern represents the number of pile picks inserted for each ground pick, plus one ground pick. For these reasons, when setting out the pattern for the working design, the margin where figure and ground meet must change or step at intervals of two or more warp ends in a horizontal direction, and at intervals of two, three or more picks in a vertical direction, according to the weave selected.

Fig. 367 is a portion of the pattern, *en bloc*, of the cloth represented in Fig. 366. A small portion of the block pattern (bracketed) is shown transposed in Fig. 368, and is developed for a tabby-back velveteen containing four pile picks to one ground pick, with pile weft bound by alternate warp ends, and in accordance with the first-named method as described in § 73. By this method pile picks are placed at the back in the ground portion and interwoven with binding warp ends in an opposite manner to that of the figure portion. The margin of figure in a vertical direction in velveteens constructed in accordance with this method is always formed with a half-tuft, *i.e.*, one-half of a complete loop, thus **J**. For this reason it is advisable to continue some short marginal floats of weft to their full extent, and to stop others that are very short (as indicated by white and black crosses respectively), and thus *prevent* short marginal tufts of pile. This object will be more easily achieved by forming the margin of *ground* (in a vertical direction) with the binding warp ends only, as observed in Fig. 368.

Fig. 369 is a portion of the same block pattern showing the development of a working design for figured velveteen, in accordance with the second method as described in § 73, by which surplus pile weft floats loosely beneath the ground portion of the fabric, to enable it to be readily brushed away after the operation of cutting, and is a reproduction of a portion of the fabric represented in Fig. 366, which is a tabby-back velveteen containing three pile picks to one ground pick, with alternate warp ends employed for binding pile weft. The scheme of binding pile picks in this example is the same as that given in Fig. 350, in which tufts of pile are omitted in a certain order, for the twofold

purpose of increasing the length, but reducing the density, of pile. It should be observed that in velveteens constructed in accordance with this method the margin of figure in a vertical direction is formed with entire tufts, as any half-tufts that may be formed during the operation of cutting are withdrawn on re-

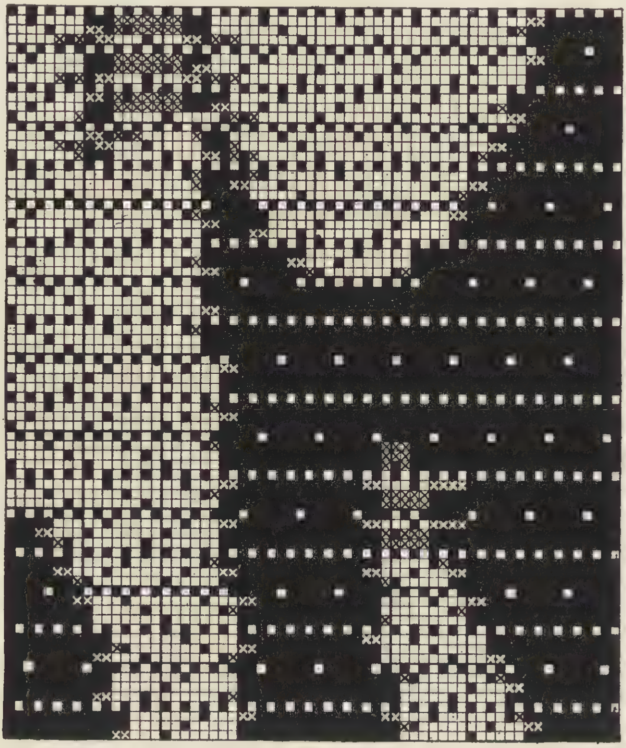


FIG. 369.—An Alternative Method of developing an Applied Design for Figured Velveteen.

moving surplus pile weft from the back. For this reason, greater care is required on the part of a designer in order to preserve a good margin of figure and ground. This may be accomplished by extending certain marginal floats into the ground portion, of sufficient length to enable the fustian knife to pass underneath and cut them, and also by filling in the

spaces to stop all floats of weft that are too short to be cut, as indicated on the working design by white and black crosses respectively. By carefully studying this design, the method of preparing designs on this principle will become manifest.

As observed in § 73 velveteens are sometimes ornamented by an operation of stamping, whereby plain velveteens are furnished with embossed designs which closely simulate those produced by Jacquard machines. The fabrics to be ornamented in this way are subjected to considerable pressure against a roller matrix of the required pattern, which depresses the pile to form the ground portion, and leaves the pile erect in the figure portion, which stands out in sharp relief as an embossed design. When put into use, the pattern of an embossed velveteen becomes indistinct and finally obliterated, in consequence of the depressed tufts of pile in the ground portion being disturbed by friction, and thereby becoming partially erect. Thus, the difference between woven and stamped figured velveteen may be easily detected by scratching the ground portion with a pointed instrument, which will raise the depressed pile in that part of the counterfeit fabric.

Corduroy.

§ 75. Corduroy fabrics are constructed on similar principles to those governing the construction of velveteens, and, like those, are submitted to an operation of fustian cutting for the development of a pile surface. They are, however, produced in much heavier and more durable textures than velveteens, in view of the greater wearing properties required of them. They consist of a foundation texture, usually based upon a three-end or four-end twill or other simple weave, containing tufts of pile disposed at regular intervals on from two to six contiguous warp ends (according to the width and character of cord required) in such manner as to develop a series of rounded pile ribs or cords in the same direction as warp ends. The ribs are usually of uniform width in the same fabric, but sometimes they are variegated. Most corduroy fabrics have pile and ground picks in the ratio of two to one respectively, with a twill foundation weave ; but some varieties known as "velvet cords" are produced in com-

paratively light textures based on the plain or tabby weave, and containing three, four and five pile picks to each ground pick, to produce a denser pile. Fabrics of this description are usually employed in the production of boys' and ladies' clothing. Figs. 370 and 371 are two designs for "velvet cords," each having a foundation texture of plain cloth, and containing three and four pile picks to each ground pick respectively. A transverse section

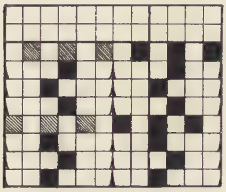


FIG. 370.—Design for Corduroy.

of cloth (before and after cutting) produced from design Fig. 371 is represented in a graphic manner in Fig. 372. As a fustian knife is thrust along each successive "race," the floats of weft are severed at or near the centre, thereby producing tufts of pile, which rise on each side of binding warp ends and form the characteristic rounded ribs of pile.

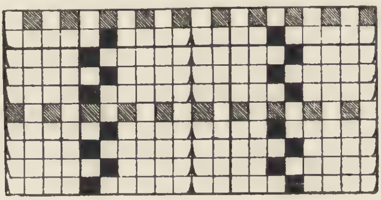


FIG. 371.—Design for Corduroy.

The rounded or convex formation of cords in corduroys is entirely due to floating weft being cut at unequal distances on each side of binding points, thereby causing each complete tuft to be formed with a long and short tuft (thus—). This will be easily understood on examining Figs. 370 and 371, in which are indicated the points at which floats of weft are severed by the fustian knife. In Fig. 370 the binding points of pile picks occur in the same order for each rib, thereby producing all floats of

the *same uniform length*, and causing each cord to constitute one repeat of the design: whereas in Fig. 371 the binding points of any two contiguous ribs are in reverse order, thereby producing floats of *two unequal lengths* and causing *two* cords to constitute one repeat of the design. In the first example all floats will be cut a little *out* of the centre, and in the second example they will all be cut *exactly in the centre;* yet, in both instances, each complete tuft will be formed with a long and short tuft with precisely similar results, notwithstanding the two different methods of binding pile weft.

§ 76. Fig. 373 is the simplest and smallest design for a corduroy fabric, commonly termed "thickset" cord. It repeats on six warp ends and nine picks, and has a foundation texture based on the three-end twill weave, with two pile picks to one ground pick. The floats of weft are very short—being over only three warp ends — thereby producing

Before Cutting. After Cutting.

FIG. 372.—Graphic Diagram representing a Transverse Section of Corduroy, woven from Design Fig. 371, showing Picks of Weft entire, and also after being severed by the Fustian Knife to form Tufts of Pile.

a short stubby pile, the tufts of which are firmly bound in the ground cloth, after the manner of "lashed" pile described under the head of velveteens in § 69. Figs. 374 to 388 are other designs for corduroys showing various modifications in their con-

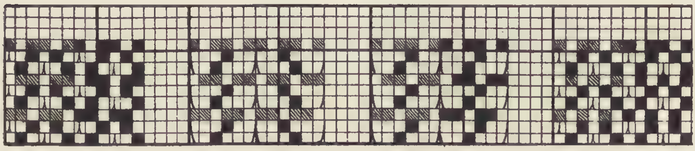


Fig. 373. Fig. 374. Fig. 375. Fig. 376.

struction as regards their foundation weaves, widths of cords, ratios of pile and ground picks, methods of binding pile weft, and many other interesting features that will become manifest to observant students and which it will well repay them to investigate.

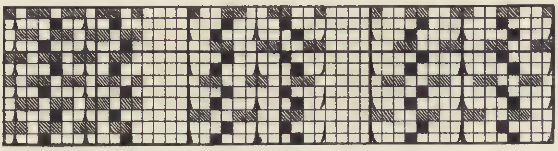


Fig. 377. Fig. 378. Fig. 379.

The irregular method of binding, exemplified in Figs. 385 to 388, is for the purpose of producing a variety of different lengths of floats, which, after cutting, will produce various lengths of pile, and thereby develop cords having a much rounder formation.

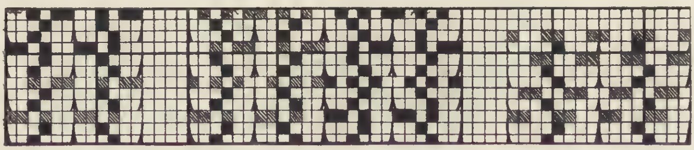


Fig. 380. Fig. 381. Fig. 382.

Figured Corduroy.

§ 77. Fabrics of the variety of corduroys known as "velvet cords" are sometimes figured on a similar principle to that which obtains in some figured velveteens, namely, by causing pile weft to float on the face in the usual manner where it is

required to form figure, and to interweave it at the back, in the ground portion, in an opposite manner. An example of figured "velvet cord" constructed on this principle is reproduced in Fig. 389, with the method of preparing a design for the same

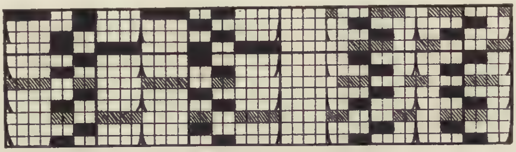


Fig. 383. Fig. 384.

shown (in part) in Fig. 390. This example has a foundation texture of plain cloth, with four pile picks to one ground pick, and with each rib extending over six warp ends. In consequence of the ornamentation of these fabrics being developed by a series

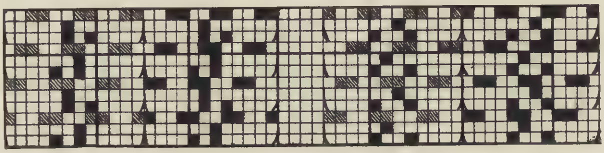


Fig. 385. Fig. 386.

of straight ribs occurring at regular intervals, it should be of a very simple character, consisting entirely of straight lines, as it would be impossible to satisfactorily develop curved lines upon them.

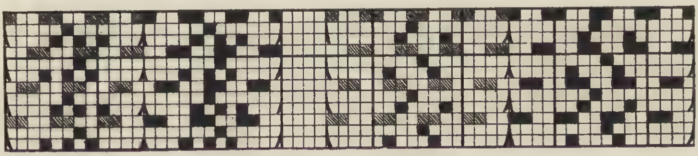


Fig. 387. Fig. 388.

Corduroy Cutting.

§ 78. The cutting of corduroy fabrics is performed, as previously stated, sometimes by hand, similarly to that employed for velveteens (as described in §§ 65 and 66); but perhaps more extensively by machinery, as their coarser and stronger texture

renders them better adapted than velveteens to mechanical cutting. Fustian-cutting machines comprise various modifications of two distinct types, known as "circular-knife" and "straight-knife" machines. A graphic full-scale diagram illustrating the operation of a "circular-knife" machine is shown in Fig. 391. In this machine all cords across the entire width of cloth are simultaneously cut by means of a corresponding number

FIG. 389.—Figured Corduroy, woven from Design Fig. 390.

of thin sharp-edged steel discs B, placed at regular intervals (coinciding with the width of cords) upon a mandril A, which extends across the machine and revolves with considerable velocity in the direction indicated by an arrow, D. As the knives revolve, cloth advances towards them in the direction indicated by an arrow, F, to a point H, where it is sharply deflected over the bevelled edge of a cross-rail G. At this point, floats of weft forming each "race" are directed and presented by means of

guide wires E to their respective knives, to be cut. A guide wire E is inserted in each "race," with the lower portion of a knife partially entering its long narrow slot. Guide wires E are pieces of steel wire bent acutely to form a long loop. The extremities of the wire are soldered together where they meet, whilst the curved

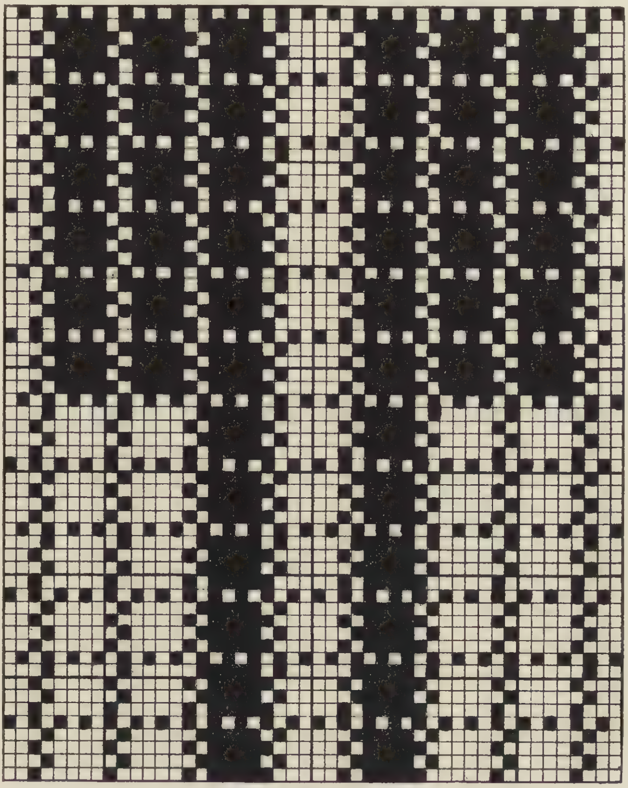


FIG. 390.—Design for Figured Corduroy represented by Fig. 389.

end is flattened and slightly bent as shown. They are inserted in the "races" of cloth with the point downward and pointing in the opposite direction to that in which cloth approaches the knives. Guide wires serve the functions of (*a*) guiding floats of weft forming a "race" to the knives, and tautening them as they are cut; and (*b*) keeping the knives (which are not rigid,

but somewhat freely placed upon the mandril) in the centre of each "race". A small segment is cut off each knife, as shown at C, to reduce their diameter at that part. Thus, by turning the mandril until the straight edges C of the knives are at the

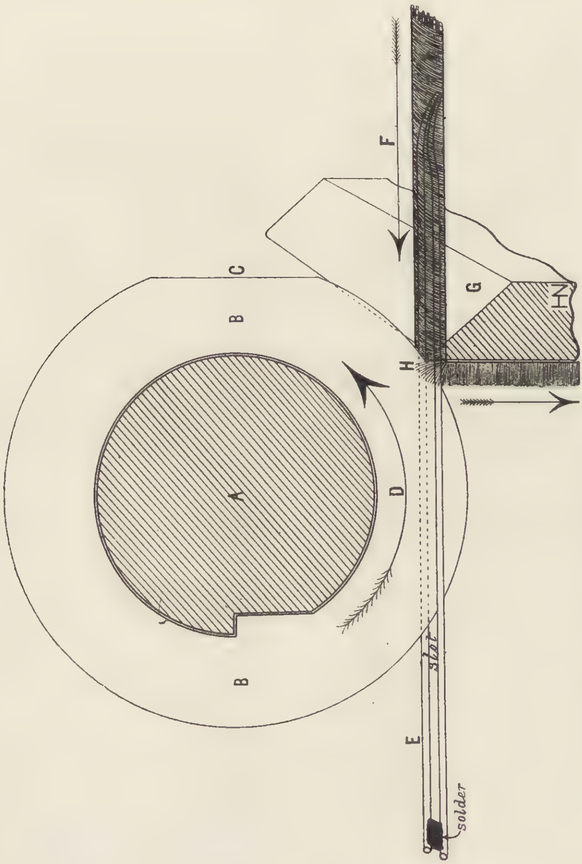


FIG. 391.—Part Section of a "Circular-knife" Fustian Cutting Machine.

cutting point H, it allows a little greater space between the knives and the rail edge, thereby facilitating the insertion of guide wires in the "races" at the commencement of cutting, or subsequently for the replacement of wires that may become injured.

As the uncut cloth approaches the knives, guide wires are conveyed along by it, and consequently require to be pushed forward again intermittently. This is accomplished by means of pushers actuated at frequent and regular intervals by a series of spirally arranged rotary cams. Each pusher acts upon three or more guide wires (according to the width of cords) at their soldered ends, so as to push them forward in groups instead of collectively, thereby ensuring greater constancy of action by preventing extreme fluctuations of energy exerted by the machine, and also of motive power required to drive it.

§ 79. Fustian-cutting machines of the second-named type are constructed with either four stationary knives, or one stationary knife, to cut four cords simultaneously, or only one cord at a time, respectively. In either case, the extremities of cloth to be cut are sewn together to form an endless band or web, which is passed through the machine at a rapid pace as often as is required to complete cutting. After each complete circuit of cloth the machine is stopped, and the knife or knives adjusted by hand to cut the next "race" or "races". In a four-knife machine, the knives (which are similar to those employed in hand cutting) are fixed at intervals corresponding to one-quarter of the width of fabric to be cut, and operate in a similar manner to a hand fustian knife, excepting that cloth advances upon the knives in the former, whilst in hand cutting a knife is thrust along cloth which is held stationary. The adjustment of knives in these machines is so contrived that, on their leaving a "race," penetrating cloth, meeting with any obstruction, or from any other irregularity, the machine automatically stops.

CHAPTER VIII.

TERRY PILE FABRICS.

§ 80. "Terry pile" is a term used to distinguish a variety of woven fabrics characterised by the formation of a series of loops (thus ∩) projecting from the main body of the fabric. These loops are produced by an extra series of comparatively slack warp ends, and may be uniformly distributed either on one side or both sides of the fabric to form a perfectly even surface; or they may be developed in such manner as to create a figured design upon a plain or bare ground. Or, again, a figured terry fabric may contain an all-over pile surface on both sides, with figure and ground developed in contrasting colours.

There are two distinct methods of developing a terry or looped pile surface during the operation of weaving, namely: (1) by means of wires that are inserted in the warp sheds at intervals (as if they were picks of weft) and subsequently withdrawn, thereby causing all warp ends that passed over them to form a corresponding number of loops; and (2) by means of what are known as "terry" motions, whereby, during weaving, several picks of weft are inserted a short distance from the "fell" of cloth (or last pick inserted), to produce a short gap or "fret," and then all are pushed forward together to take their final place in the fabric. As each group of picks are thus pushed forward by the reed, pile warp ends buckle or loop either on the face or back of cloth as predetermined, and so develop the characteristic loops of pile known as "terry," looped, or uncut pile.

Examples of looped pile fabrics produced by the aid of wires are seen in Brussels and tapestry carpets, moquette, mohair and other furniture upholsterings of heavy texture, as well as in silk upholsterings of light texture and great beauty. In

fabrics of this description the pile is formed on one side only, and (with the exception of tapestry pile carpets) pile warp ends may sometimes lie perfectly straight or interweave as ordinary warp ends, and then be required to form pile, all within a short interval. Under these circumstances, pile warp ends are separately contained upon a corresponding number of bobbins that are separately weighted to permit of the independent withdrawal of their threads, and thus provide for their variable and irregular contraction. If all pile warp ends were contained on the same warp beam, they would necessarily have to either form pile or else lie straight uniformly at the same periods, in consequence of their uniform and simultaneous delivery during weaving.

§ 81. Terry fabrics produced by means of terry motions are exemplified in so-called Turkish towels, bath mats, counterpanes, antimacassars, toilet covers and mats, and many articles for domestic purposes. The majority of these goods are produced entirely from cotton, although terry towels are sometimes produced either entirely or in part from linen. Terry weaving is a principle eminently adapted to the production of towels, as the loops of pile give considerable bulk and impart good absorptive properties to the fabric. The variety of terry fabrics under present notice are produced from two series of warp ends, namely : (*a*) ground, and (*b*) pile warp ends, each of which is contained on a separate warp beam. They are usually employed in equal proportions, and arranged in the harness and reed either alternately with each other or in alternate pairs of ground and pile threads. The particular disposition of warp ends is arbitrary. Some advocate an alternate distribution of ground and pile warp ends, whilst others prefer to dispose them in alternate pairs of each series of warp ends. In both cases the ultimate results are virtually alike. During weaving ground warp ends are held taut, whilst the beam containing pile warp ends is very lightly weighted to enable the threads to be easily withdrawn for the formation of pile. Terry fabrics are termed three, four, five or six-pick terrys, according as there are three, four, five or six picks inserted between each horizontal row of loops respectively. Most of these fabrics are constructed with three picks for each row of loops. The object of inserting a greater number of picks

for each row of loops is to produce a superior fabric and to bind pile warp ends more firmly to the foundation texture.

§ 82. Before describing the construction of terry fabrics it will be better to briefly describe the general features of terry-forming devices, as that will be helpful to a clearer understanding of the essential conditions governing the construction of such fabrics. Terry motions are usually based upon one or other of three distinct mechanical principles. By far the greater number are constructed on what is known as the "loose-reed" principle, illustrated in Fig. 392. Devices based upon this principle are

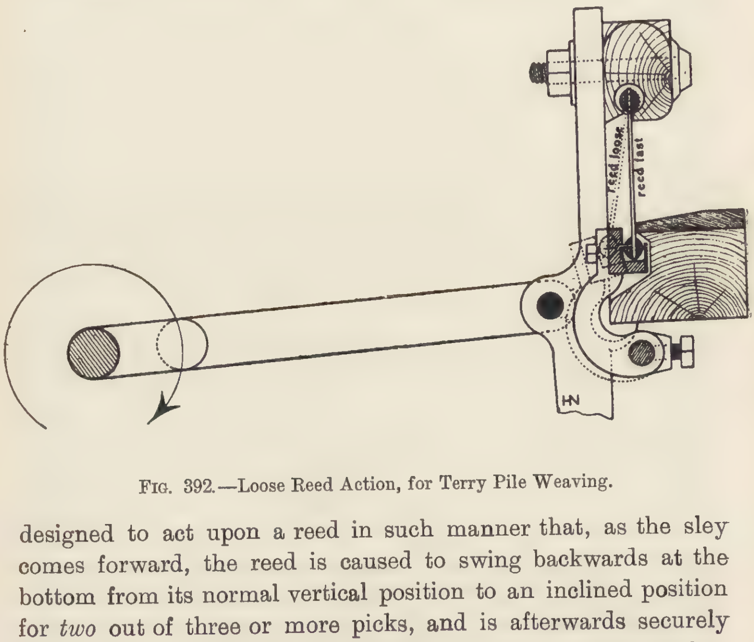


FIG. 392.—Loose Reed Action, for Terry Pile Weaving.

designed to act upon a reed in such manner that, as the sley comes forward, the reed is caused to swing backwards at the bottom from its normal vertical position to an inclined position for *two* out of three or more picks, and is afterwards securely fastened in its normal position for the following pick (or picks), when all are pushed forward together to take their final place in cloth. As picks are thus pushed forward from their temporary to their final position, they slide along the tense ground warp ends; but the degree of frictional resistance between the three picks and slack pile warp ends is sufficient to draw the latter forward *en masse*, and thus cause them to bend and form a series

of loops. As the reed swings backward at the bottom, for the two "loose" picks, it swivels on the upper ribs which are retained in a mortise cut into the under side of the sley cap. Therefore, since the line of contact made by the "fell" of cloth with the reed is situated approximately midway between the upper and lower ribs of the latter, it follows that the bottom of the reed will require to recede (for the two "loose" picks) for a distance of not less than twice the length of gap or "fret" necessary to yield the desired length of pile on the fabric. Such excessive backward movement of the reed creates a tendency to develop loops of pile of irregular lengths in different *horizontal* rows of pile, but not in the individual rows. This tendency arises in consequence of the abnormal inclination of the reed from its vertical position, whereby it inclines forward at the top, and therefore bears downward upon the "loose" picks as it approaches the "fell" of cloth. Hence, those picks tend to slide downward along the reed for a greater or less distance (according to circumstances to be presently stated), and, thus produce gaps or "frets" of different lengths, and, therefore, different lengths of pile. This evil is more liable to manifest itself in *figured* terry fabrics in which the number of pile warp ends either raised or depressed is liable to fluctuate according to the design. Thus, the "fell" of cloth will occupy a higher or lower plane during beating up, according to the preponderance of warp ends in either the upper or lower half of the warp shed, respectively; also, the strain upon the reed, as it approaches the "fell" of cloth, will be greater or less in proportion to the number of warp ends forming the bottom half of the warp shed, because they bear against the reed farthest from the upper ribs on which it swivels in the sley cap.

A modification of the "loose-reed" principle, for terry weaving, is designed with the object of overcoming the disadvantages of the system just described. This modification is effected by mounting the reed in a case or frame carried at the upper ends of two long vertical arms that extend downwards and are respectively fulcrumed either upon studs secured to the sley swords, or else upon the rocking shaft on which the sley oscillates. The said arms are analogous to auxiliary sley swords for the sole

purpose of supporting the reed only, so that the latter may be carried *bodily* backward, with the least deviation from its normal vertical position, when beating up the two "loose" picks to produce the desired length of gap or "fret" at the "fell" of cloth.

A second type of terry motion causes the sley to oscillate for a shorter distance for two consecutive picks, and for a greater distance for the third and following picks inserted for each horizontal row of loops. By this means, two out of three or more picks are beaten up within a short distance from the "fell" of cloth, and then after the third pick is inserted in the shed they are all three pushed forward together as described.

A third type of terry motion (which is of little reputation) operates in a contrary manner to either of the foregoing. Thus, instead of causing the reed to recede for a short distance from the "fell" of cloth, the latter is drawn a short distance in advance of the reed for the two "loose" picks; whilst the reed is fixedly mounted in the sley, as in a "fast-reed" loom. This is accomplished by moving the back rail and breast rail of a loom to and fro simultaneously, so as to carry the stretch of warp and cloth bodily forward for two out of three or more picks, after which, the back rail and breast rail return to their normal position, thereby causing all picks to be pushed forward to their final place in cloth.

§ 83. Fig. 393 is the design for a plain three-pick terry fabric having pile formed on both sides, and with warp ends arranged in the order of one ground and one pile warp end alternately. (Shaded squares in the design represent pile warp ends and black squares ground warp ends.) In the production of terry piece-goods, such as roller towelling, not more than four healds are necessary, namely, two for each series of warp ends; but in the production of separate towels, with "headings" or borders, it is usual to employ five healds, namely, two (at the front) for pile warp ends, and three (in the rear) for ground warp ends, drafted in the manner indicated above the design. When pile and ground warp ends are arranged alternately, one of each series is drawn through each dent of the reed; but when they are drafted in pairs they are also passed through the reed in pairs,

so that two warp ends of the same series are contained in the same dent. In § 88 the relative merits of each system of drafting and other practical considerations are stated. On examining the design, Fig. 393, it will be seen that consecutive ground warp ends interweave in an opposite manner to each other, as do also consecutive pile warp ends. Pile warp ends that are *over two picks* and under one pick form pile on the face, whilst those that are *under two picks* and over one pick will form pile at the back of cloth when in the loom.

§ 84. In the production of terry fabrics without the aid of wires it is absolutely essential to observe a specific order of shedding in relation to the action of the reed as governed by the terry motion,

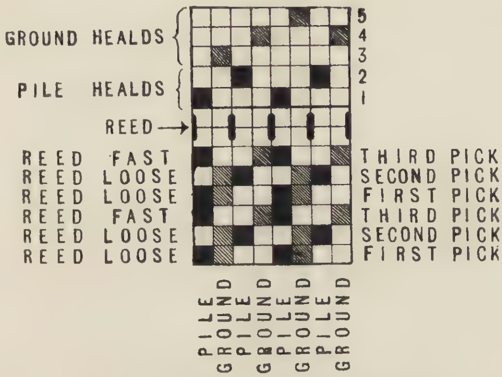


FIG. 393.—Design for a 3-Pick Terry Pile Fabric.

otherwise the loops of pile will be imperfectly developed or may not appear at all. This order is clearly indicated in the design (Fig. 393) and also in the graphic diagram (Fig. 394) which represents a longitudinal section of a three-pick terry fabric. On examining these figures it will be seen that the reed is "loose" for the first and second picks, termed "loose" picks, and "fast" for the third pick, termed the "fast" pick. It will also be observed that the "loose" picks are always inserted in *opposite pile warp sheds*, but in the *same ground warp sheds*. With this order of shedding in relation to the reed motion, pile warp ends make two intersections, and ground warp ends only one intersection with the picks, before the latter are beaten up to

the "fell" of cloth; hence, the picks easily slide along ground warp ends which are held taut, whereas their better grip of pile warp ends which are slack causes the latter to be drawn forward and form loops of pile.

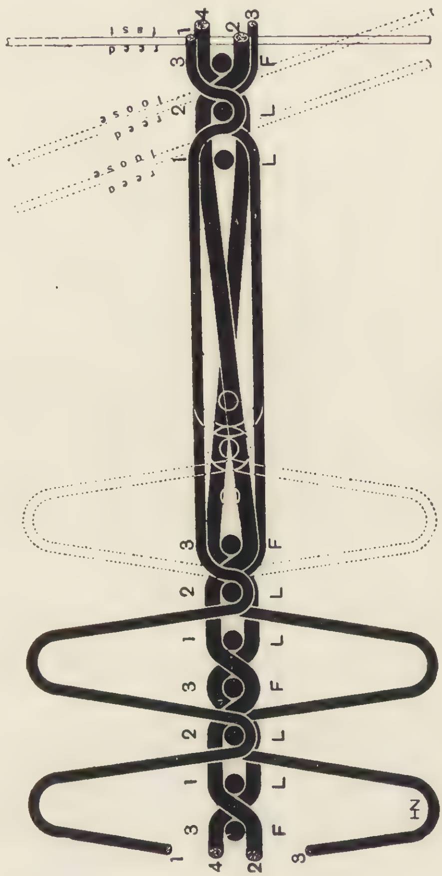


FIG. 394.—Graphic Diagram of a 3-Pick Terry Fabric, to demonstrate the action of the Reed, and the formation of Loops of (Terry) Pile, during Weaving.

§ 85. As stated in § 81, the number of picks inserted between each horizontal row of loops in terry pile fabrics produced by the aid of terry motions varies in different fabrics from three to six picks. The number of picks selected does not, however,

affect the primary factor governing the construction of those fabrics as regards the order of shedding in relation to the timing of the reed motion as described in § 84. This is specially emphasised because it constitutes one of the most essential conditions in terry weaving, and the want of such information sometimes proves a stumbling-block to the successful production of terry cloth. It should also be observed that the relative density of loops of pile is relatively greater or less in inverse proportion to the number of picks inserted for each horizontal row of loops.

Fig. 395 is the design for a four-pick terry fabric having pile equally distributed on both surfaces. A longitudinal section of

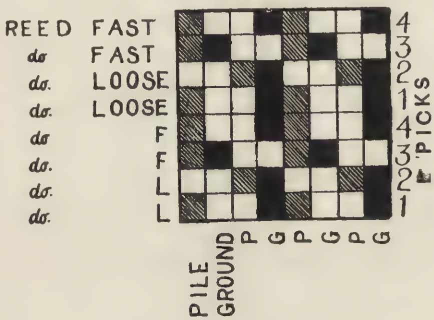


Fig. 395.—Design for a 4-Pick Terry Pile Fabric.

cloth produced from that design is graphically represented in Fig. 396. It differs from a three-pick terry fabric by having two picks (the fourth and first that are contiguous) inserted in the same warp shed, a circumstance which necessitates the use of a "catch-cord" for one of the selvedges. (A "catch-cord" is a device to govern extreme outer selvedge warp ends, so that weft will be caught by them and thereby prevented from being pulled backward into the warp shed in the event of a shuttle passing through the same shed for two or more picks in succession.) By inserting four instead of three picks for each horizontal row of loops, a firmer and heavier texture is produced. Also in the manufacture of those fabrics in which differently coloured threads are employed to produce simple counterchange effects (as exemplified

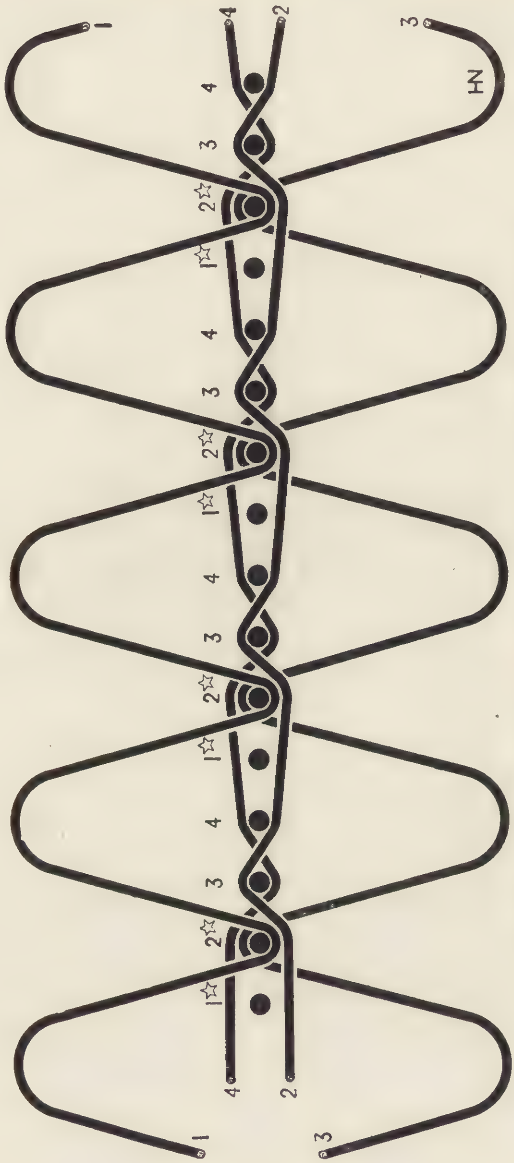


FIG. 396.—Longitudinal Section of a 4-Pick Terry Fabric woven from Design Fig. 395.

in many terry towels and bath mats) it enables a sharper and more perfect definition to be made at the horizontal edges of figure, where pile threads pass from face to back, and *vice versâ*. The starred numbers 1 and 2 in Fig. 396 and subsequent diagrams of terry fabrics signify that the reed is loose for the picks indicated, and fast for the intermediate picks, during weaving.

§ 86. Another modification in the construction of terry fabrics is exemplified in the well-known Turkish towel, sold under the trade name of "Osman," of which the design and longitudinal section are given in Figs. 397 and 398 respectively. So far as

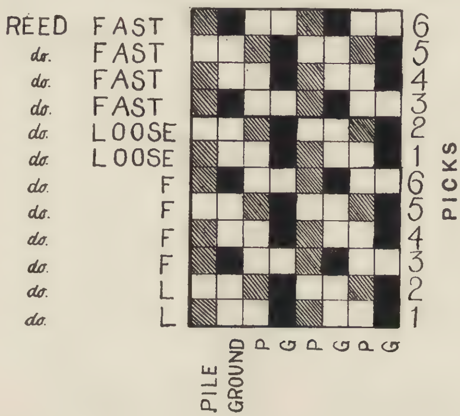


FIG. 397.—Design for "Osman" (6-Pick) Turkish Terry Fabric.

the structural design of this fabric is concerned, it is identical with that of an ordinary three-pick terry fabric (Fig. 393), which repeats on three picks. In the production of "Osman" Turkish towels, however, the reed is governed so as to be loose for two out of six picks (instead of for two out of three picks, as in a three-pick terry fabric), thereby causing six picks to be inserted for each horizontal row of loops, as shown in diagram Fig. 398. Terry fabrics constructed on this principle are of relatively stronger and firmer texture than either of the previous examples; also pile warp ends are more firmly interwoven with the foundation texture, and therefore less liable to be accidentally or otherwise withdrawn when the fabric is in use. In the pro-

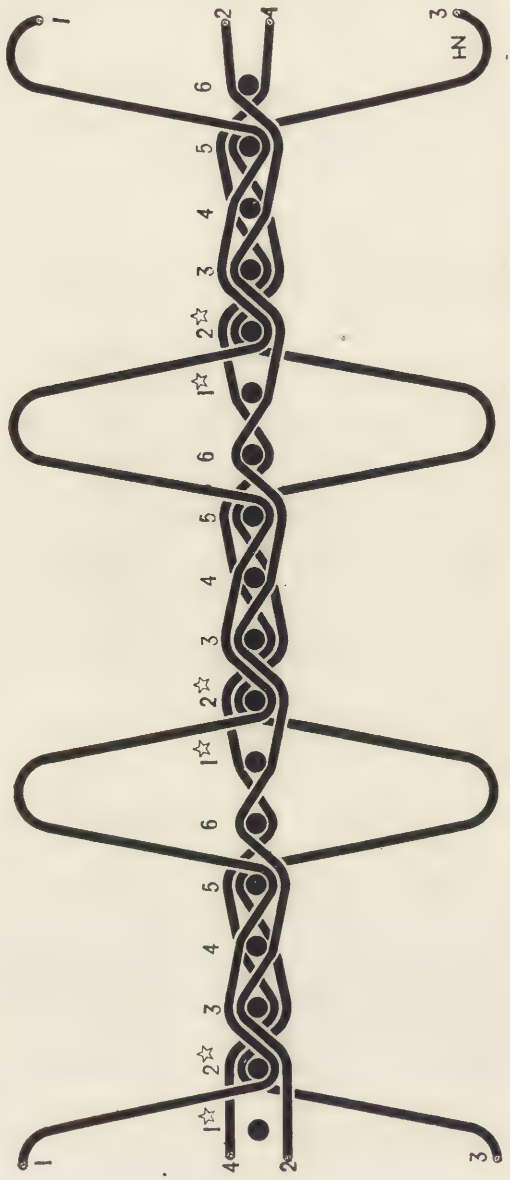


FIG. 398.—Longitudinal Section of a 6-Pick ("Osman") Terry Fabric, woven from Design Fig. 397.

duction of six-pick terry fabrics, the reed is loose for picks 1 and 2, and fast for picks 3, 4, 5 and 6.

§ 87. Figs. 399 and 400 are a design and longitudinal section respectively of a five-pick terry fabric such as is frequently met with in the form of counterpanes, toilet covers and antimacassars, on which more or less elaborate Jacquard designs are produced in pile upon a plain or bare ground. These fabrics are usually woven by means of specially constructed Jacquard machines which greatly facilitate the preparation of designs. Instead of indicating the actual working of each warp end and pick on the design, the latter is prepared *en bloc*, as indicated at A, Fig. 399. The actual working of the threads is indicated in the same Fig. at B. Filled squares at A represent terry pile figure, and blank squares represent ground. All pile warp ends loop at the same time, either on the face or at the back of cloth; thus, where pile is formed on the face it is plain at the back and *vice versâ*. During weaving, the reed is loose for picks 1 and 2, and fast for picks 3, 4 and 5.

It will be observed that in the three, four and six-pick terrys, consecutive pile warp ends always intersect with weft in an entirely opposite manner to each other; whereas, in the present example of five-pick terry weaving, when pile warp ends are forming pile on the face they interweave in a different manner from that when forming pile at the back. Thus, when forming pile on the face, pile warp ends interweave over two picks, under one, over one, and under one pick; whereas, when forming pile at the back, they interweave under four picks and over one pick. The object of this arrangement is to cause pile warp ends to intersect less frequently with picks of weft, and so permit of a greater number of picks per inch to be inserted in cloth. Such a course, however, involves a less secure interlacement of pile warp ends with the foundation texture.

§ 88. In § 83 reference was made to different systems of drafting warp ends through the harness and reed for the production of terry fabrics. In that section it was stated that pile and ground warp ends were sometimes disposed in the harness and reed alternately, and sometimes in alternate pairs, with practically similar results. Theoretically, it would appear that

an alternate disposition would ensure a more uniform distribution of each series of warp ends; but on this point there is

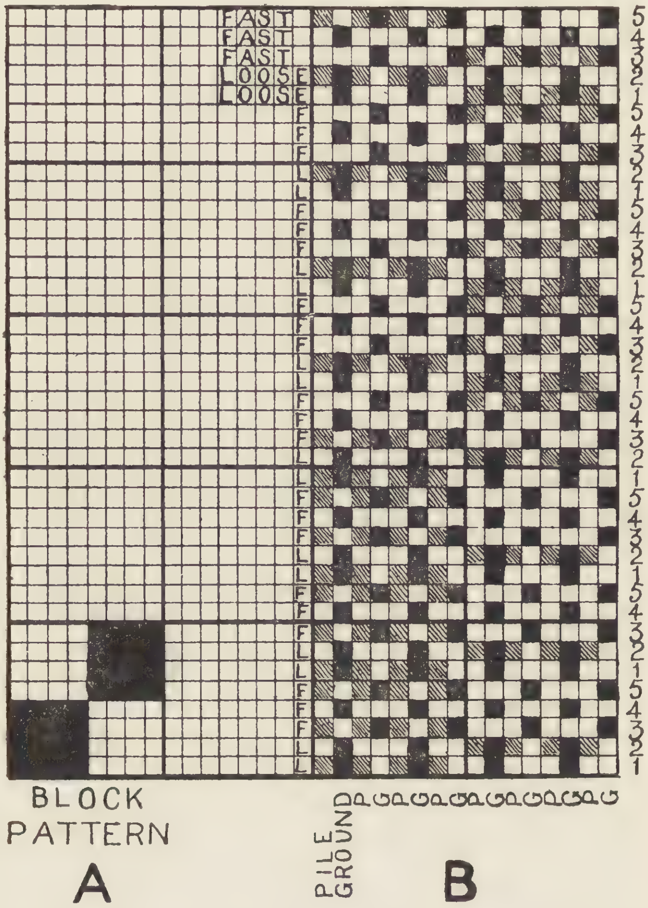


FIG. 399.—(B) Showing the manner in which Warp and Weft would interweave in a 5-Pick Figured Terry Fabric, to develop the Pattern indicated *en bloc* at A.

little, if any, appreciable difference between the two arrangements. In practice, however, an advantage is afforded by the

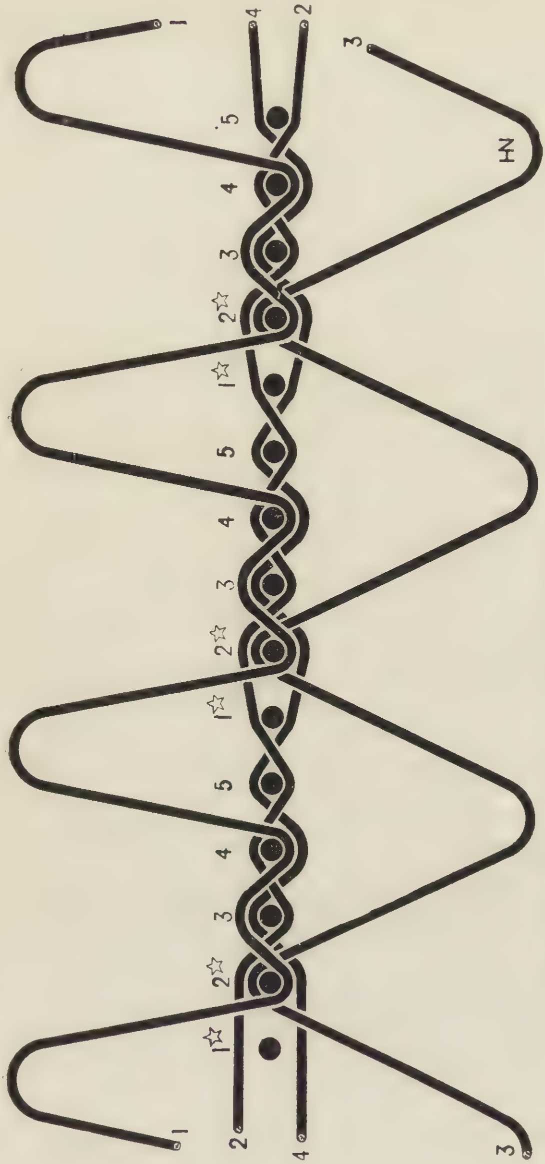


FIG. 400.—Longitudinal Section of a 5-Pick Terry Fabric woven in accordance with Design Fig. 399.

two-and-two over the alternate disposition of warp ends. This arises from the fact that, with such a disposition of the two series of threads, either consecutive pile warp ends or consecutive ground warp ends always interweave in an opposite manner to each other (excepting in the example of five-pick terry fabric just described). Therefore, by placing two threads of the same series in the same dent of the reed, they are never either up or down together for the same picks of weft, but always occupy opposite positions; whilst a reed wire separates a pile and ground warp end that are contiguous, and that are sometimes up or down together at the same time. Hence, these two circumstances conduce to the formation of a clearer warp shed for the passage of a shuttle during weaving.

In the production of terry pile fabrics of strong and heavy textures, such as linen Turkish towels, it is a common practice to employ what is termed a double reed. Such a reed virtually consists of two reeds placed one behind the other, with a space of about $\frac{1}{8}$ in. between them, and constructed in such manner that the wires of one reed are placed exactly midway between those of the other, thereby constituting a compound reed whose practical counts or sett equals twice that of the single reeds. The objects of such a reed are to obtain greater resistance when beating up weft, and also to gain a little more space for yarn and thereby diminish the abrasive frictional action of the reed upon the warp ends.

Another practical point in terry weaving has reference to the manufacture of those fabrics in which coloured threads are employed for the production of striped counterchange effects, as seen in roller towelling and bordered towels. It is well known to all practical men that however near to the reed the temples are placed, there is a greater or lesser degree of contraction in width at the fell of cloth. It follows, therefore, that the inward pull of cloth will cause warp ends to bear on the outer sides of reed wires around which they bend. For this reason it is found advantageous (when pile and ground warp ends are alternated with each other) to place pile warp ends on the *left*, and ground warp ends on the *right*, through each dent towards the *left-hand* selvedge, and in the reverse order through the dents

towards the *right-hand* selvedge. The object of this arrangement (which is particularly desirable where figured counterchange stripes occur) is to cause ground warp ends, which are taut, to bear against the reed wires, and to allow pile warp ends, which are slack, to lie on that side of ground warp ends nearest the selvedges, and so avoid the risk of pile warp ends being impeded in their passage between reed wires and ground warp ends; an evil which is liable to occur if that course is not adopted.

CHAPTER IX.

GAUZE AND LENO FABRICS.

§ 89. "Gauze" and "leno" are terms which designate different varieties of one of the most interesting types of woven fabrics comprised under the generic term of "cross-weaving". The distinctive characteristic feature of this type of fabrics is the peculiar *crossing of warp ends with each other,* caused by pulling them out of their normal straight and parallel course, first to one side and then to the other side, of other warp ends, which cross and recross in some definite order.

Cross-weaving is a useful principle extensively adopted in the production of silk, cotton, worsted and linen textures, for almost every variety of purpose—as ladies' and children's wearing apparel, curtains, antimacassars, and many others. It is also frequently applied in combination with tissue, lappet and swivel figuring (described in Chapter X.) piqués, and many other types of fabrics. When it is applied to fabrics of an extremely light, open and flimsy texture, and especially if produced from silk, they are usually described as "gauze" fabrics; but if applied decoratively to heavier textures of cotton and linen, they are usually termed "leno" fabrics, of which there are two distinct classes, namely, (1) "net leno," and (2) "leno brocade" fabrics, each comprising several varieties.

"Net lenos" are chiefly produced by means of healds, and are usually characterised by a decidedly striped formation developed by the introduction of comparatively coarse threads, termed "net" warp ends, which usually assume a more or less zigzag course, and produce a series of "net" leno stripes. Sometimes the vertical stripes are crossed by a series of horizontal ones to produce a "check" pattern. Net leno fabrics

offer unlimited scope to a capable designer in the production of decorative leno effects, which are frequently of a most interesting and sometimes of a very beautiful and attractive character. And it is, perhaps, not too much to say that no other principle of weaving is capable of yielding such variety of exquisite decorative effects for so small an expenditure of artistic or technical effort.

"Leno" brocades are ordinary brocade fabrics in which the gauze principle of weaving is introduced as an additional means of embellishment. They are produced by means of a Jacquard machine, and usually consist of a gauze or leno figure surrounded by a ground of the plain or calico weave, or *vice versâ*; and sometimes either warp, weft, or both are allowed to float where required for the purpose of developing ordinary brocade figuring. An interesting variety of leno brocade fabrics are those in which both leno brocade and also net leno figuring are employed for the development of stripes of each kind arranged either alternately or otherwise. In the production of this variety of fabrics it is usual to employ a compound harness consisting of a Jacquard mounting for the leno brocade stripes, and a heald harness for the net leno stripes.

Plain Gauze.

§ 90. The simplest example of gauze or cross-weaving is that in which one or two warp ends in regular succession cross each other on successive picks, or pairs of picks, so as to produce an open net-like structure of uniform texture, as represented at C, Fig. 401. This diagram indicates the method of drafting warp ends through the healds and reed at A, and the order of shedding at B, to produce the gauze structure represented at C. By studying that diagram in conjunction with those given in Figs. 402, 403 and 404, the principles of cross-weaving, which are generally so puzzling to students, will be easily understood.

Shedding harnesses for cross-weaving, whether they consist of healds or Jacquard mountings, may be constructed on either of two systems known as a "bottom-doup" or a "top-doup" arrangement, according to whether the "doups" are situated

below or *above* warp ends respectively, as will be presently explained. A heald harness with a "bottom-doup" arrangement,

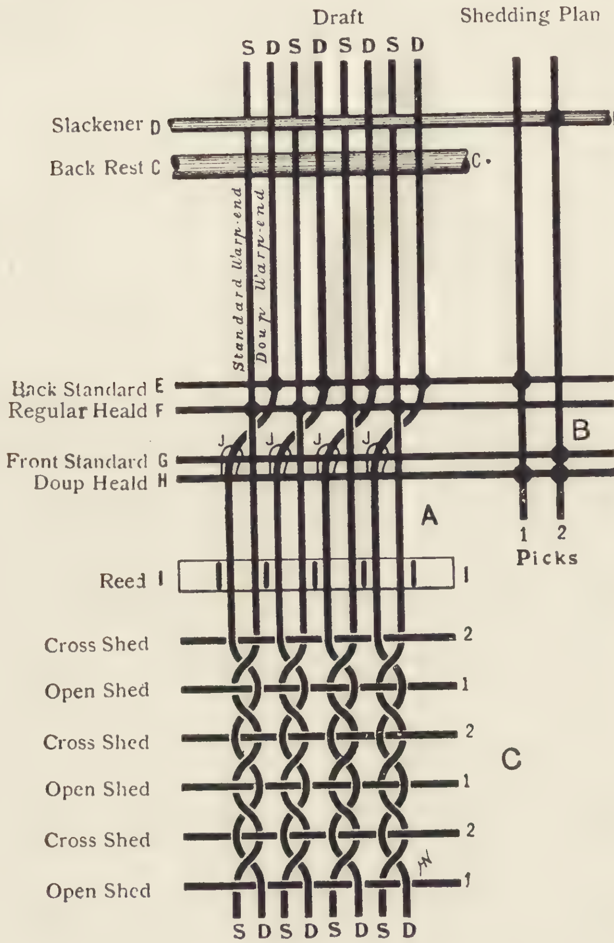


FIG. 401.—Graphic Diagram representing a Plan of Simple Gauze Cloth, at C; also the method of drawing-in Warp Ends through the Healds and Reed, at A; and the Shedding Plan, at B.

and also the formation of the sheds for the production of plain gauze, are graphically represented by diagrams Figs. 402, 403

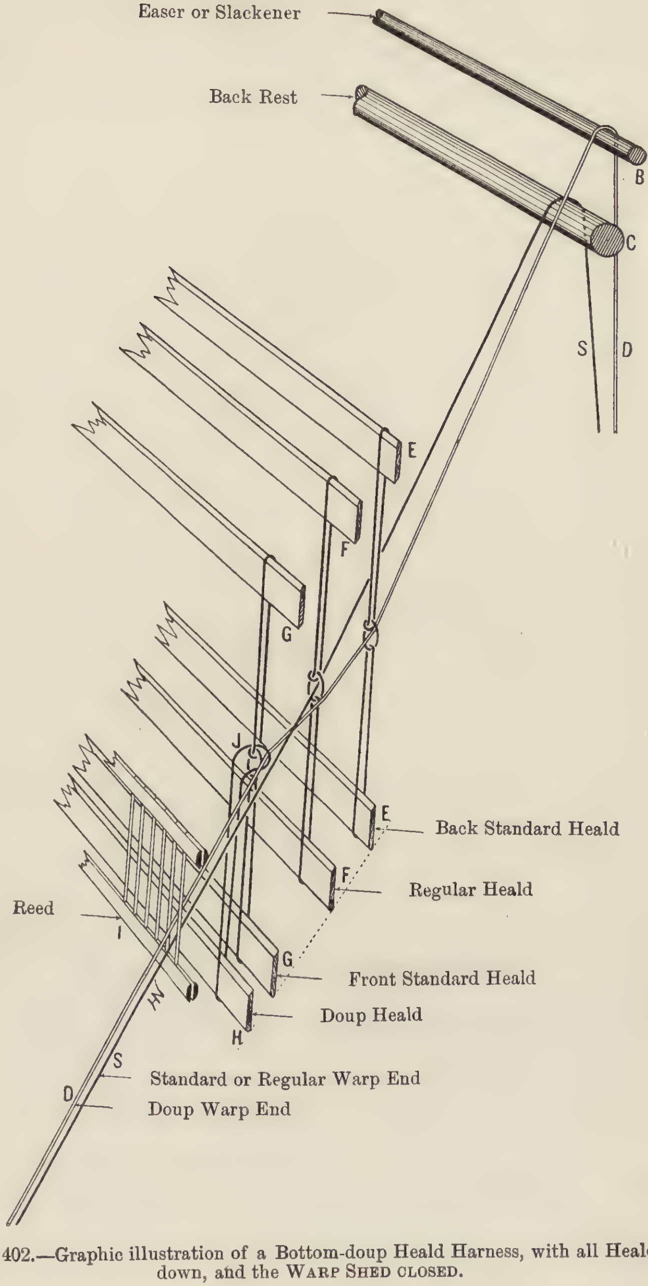


FIG. 402.—Graphic illustration of a Bottom-doup Heald Harness, with all Healds down, and the WARP SHED CLOSED.

and 404. In those diagrams, the healds are shown perspectively, and with the object of making their functions clear and distinct only one heald eye is shown on each heald. Fig. 402 shows all parts in their normal or inoperative position. Warp ends, all of which come from the same warp beam, are separated into two divisions of alternate threads respectively termed "standard" or "regular" warp ends S, and doup warp ends D.

The essential features of this harness are—a heald (G), termed the "front standard," situated immediately in front of all other healds, and a half-heald termed the "doup heald" (H) placed in front of the front standard, and consisting of a number of loops or slips (J), termed "doups," whose upper parts pass *over* the eyes of the "front standard," and return *through* them, to prevent their withdrawal. The doups are attached to a single heald-stave (H), situated *below* warp ends; hence the term "bottom-doup" as distinguished from a "top-doup" harness, in which the doups are attached to a stave situated *above* warp ends.

Standard warp ends pass from the warp beam to cloth in a perfectly straight course, first over the back rest (C), thence through the respective eyes of a regular heald (F), and through a dent of the reed (I). Doup warp ends pass over a bar variously termed the "easer," "vibrator" or "slackener" (B), situated a little to the rear of, and in a little higher plane than, the back rest (C); thence through eyes of a heald (E) termed the "back standard". From here they pass *in front* of heald eyes governing standard warp ends, and then cross *underneath* the latter from right to left, after which they pass through a loop (J) attached to a single heald-stave (H) (situated *below* warp ends), and finally they pass through the *same dents* of the reed (I) as their fellow standard warp ends.

(In order to prevent confusion of terms, the attention of students is specially directed to the apparent inconsistency in the use of the term "back standard" to describe those healds (E) which govern doup warp ends when the latter are raised on the normal side of their respective standard warp ends (to form "open" sheds), instead of that term being used to describe the regular healds (F) which govern standard or regular warp ends.

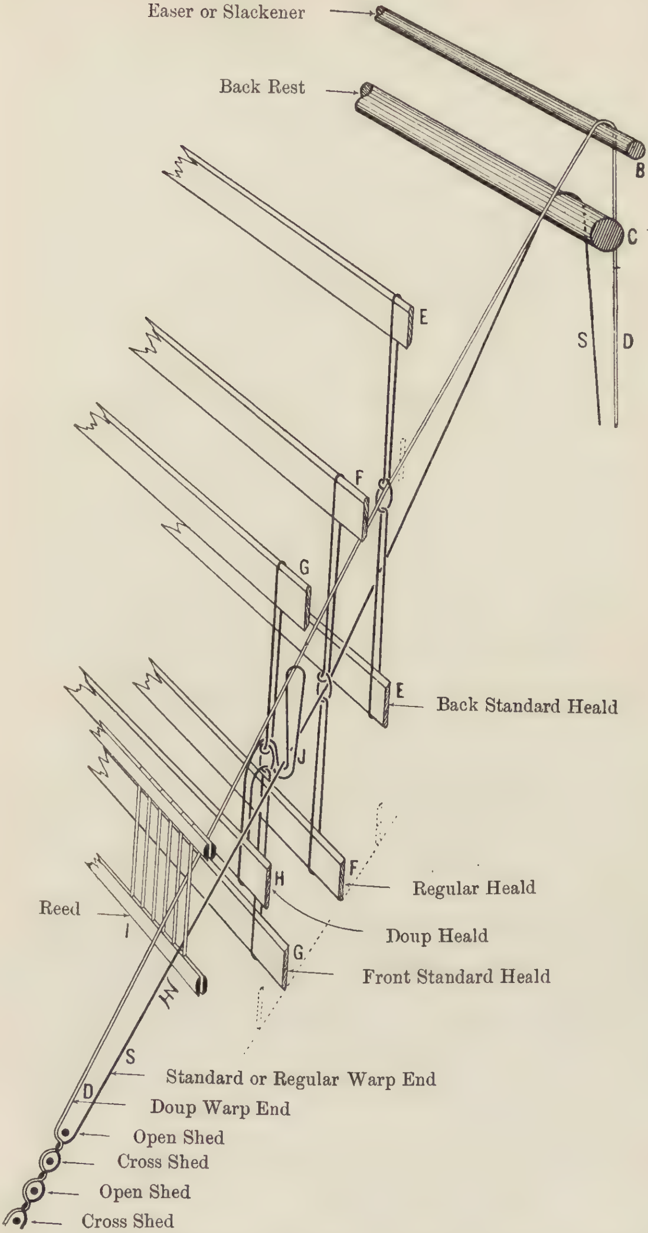


FIG. 403.—Graphic Diagram of a Bottom-doup Heald Harness, showing the Formation of an OPEN SHED.

The term "*back* standard," however, is that established by custom to distinguish the healds that are complementary to, and which govern doup threads in conjunction with, "*front* standard" healds).

§ 91. In the production of a simple gauze texture entirely devoid of figuring, two distinct forms of shedding are required, namely, a straight or "open" shed, and a "cross" shed. A straight or open shed is one in which warp ends are separated without being deviated from their normal parallel course. Its formation with a bottom-doup harness (as illustrated in Fig. 403 and indicated in the shedding plan of Fig. 401) is effected by raising both the back standard heald E (which controls "doup" warp ends) and the "doup" heald stave, H. By raising the half-heald stave, "doups" J become slackened, and thereby release their control of "doup" warp ends, which are quite free to return from their crossed position on the *left*, to their open or parallel position on the *right* of standard warp ends. Thus by raising the "back standard" E, "doup" warp ends are raised on that side of "standard" warp ends which they occupy before being crossed underneath those threads, without being impeded by the "doup" slips, which, being slack, are taken up by their respective "doup" warp ends.

A "cross" shed is one in which "doup" warp ends are raised on the *opposite* side of "standard" warp ends to that which they occupy in the healds *before* being crossed—that is, on their *crossed* side. Its formation, as illustrated in Fig. 404, is accomplished by raising both the "front standard" heald G and the "doup" heald H together. Unless means were adopted for its prevention, the formation of a "cross" shed would impart abnormal tension to "doup" warp ends, in consequence of the short interval or "stretch" of warp between the "fell" of cloth and the eyes of heald F, around which "doup" warp ends bend on being raised. Such undue strain is prevented by passing "doup" warp ends over an easing bar or "slackener" B, situated in the rear of the back rest C. By that means "doup" warp ends are allowed a little longer course or "stretch" between the warp beam and "fell" of cloth. Thus, when a "cross" shed is formed the "easer" or "slackener" is brought

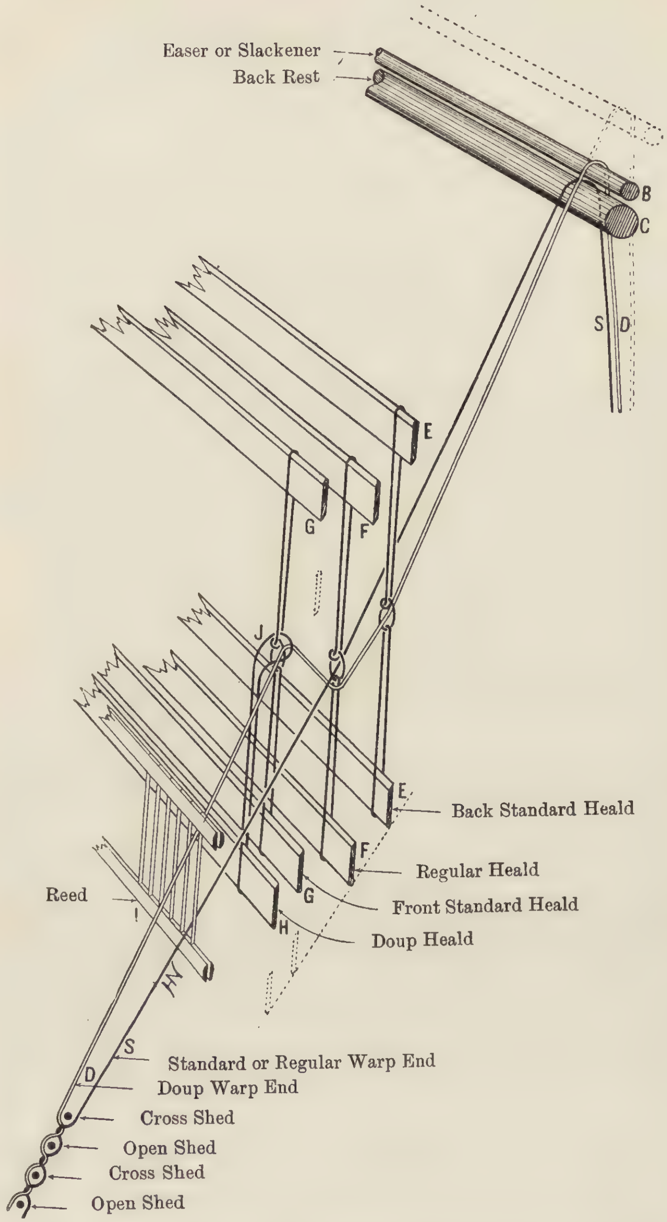


FIG. 404.—Graphic Diagram of a Bottom-doup Heald Harness, showing the Formation of a CROSS SHED.

forward from its normal position (indicated by dotted lines) to slacken the "doup" warp ends, and thereby prevent undue tension being imparted to those threads. This function is variously described as "easing," "slackening" and "vibrating".

An examination of the gauze structure represented in Fig. 401, and also of Figs. 403 and 404 will show that "standard" warp ends are *never* raised, and that "doup" warp ends are raised for *every pick* of weft inserted—first on the right and then on the left of "standard" warp ends alternately. That peculiarity, however, is characteristic of plain gauze weaving only, and not of cross weaving generally; otherwise the development of figuring (as exemplified in "net leno" and "leno brocade" fabrics) could not be accomplished. In those fabrics all warp ends, whether "standard" or "doup" threads, may be raised as desired to produce any ordinary woven effect in combination with cross weaving, and their construction is governed by the same general principles as those underlying the construction of simple gauze.

Net Leno Fabrics.

§ 92. In the production of typical net leno fabrics (as exemplified in the accompanying photographic reproductions), the number of doup healds, front standard healds, back standard healds, easers or slackeners, and extra warp beams containing the net doup threads, must severally correspond with the number of different schemes of douping in a single fabric. Thus, if all doup warp ends in a piece of cloth cross their standard threads either in the same direction or in opposite directions simultaneously, only one doup heald and one each of the other several parts just enumerated would be required for its production. The direction in which doup threads cross is quite arbitrary. They may cross uniformly either in the same direction, or in reverse directions (at the same time) as predetermined by the manner in which they are crossed in the shedding harness before being passed through their respective doups. If they are crossed over (in the harness) in the same direction uniformly, they will all cross in the same direction and at the same time in cloth, as

exemplified in the second net leno stripe B, Fig. 409 ; but if some doup threads are crossed over to the right, and others to the left, of their respective standard warp ends, they will always cross in opposite directions in cloth. Thus, by drafting alternate doup threads in one direction, and intermediate threads in the opposite direction, a neat diamond formation may be produced, as exemplified in the net leno stripe A, Fig. 405, which illustrates an example of net leno weaving produced by means of only one

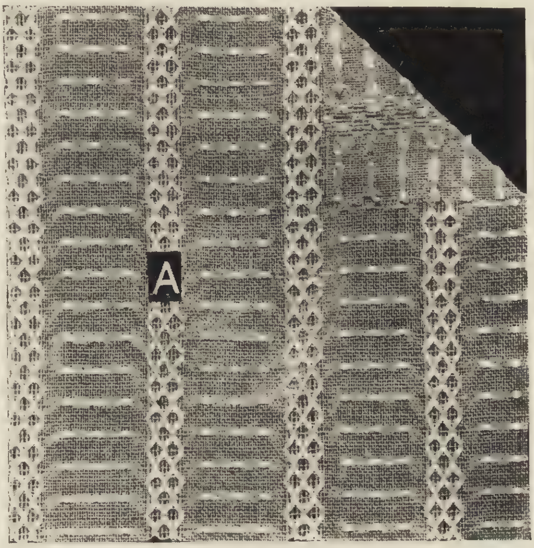


FIG. 405.—One-doup Net Leno Fabric, for which the Design, Draft and Shedding Plan are given in Fig. 406.

set of doups operating in conjunction with one back standard heald.

For reasons subsequently stated in § 107 (in which the relative merits of a *top* and a *bottom*-doup harness are compared), it is usual to weave net leno fabrics with a *top*-doup harness. For this reason, the "drafts" and shedding plans, for the samples of leno fabrics represented in the accompanying illustrations, are adapted for top-doup harnesses. With such a harness, the conditions of shedding which obtain in respect of a bottom doup harness, as

explained in § 91, are simply reversed, just as if a bottom-doup harness were inverted. By inverting the diagrams representing a bottom-doup harness, given in Figs. 402, 403 and 404, and also by reversing the shedding plan given in Fig. 401 (except that for the easer), the conditions of a top-doup harness will be faithfully represented (excepting that, being ink lines drawn on paper, and not material threads, the relative positions of standard and doup warp ends remain the same, whereas doup warp ends should cross over the *top* of standard warp ends). Thus, an open shed

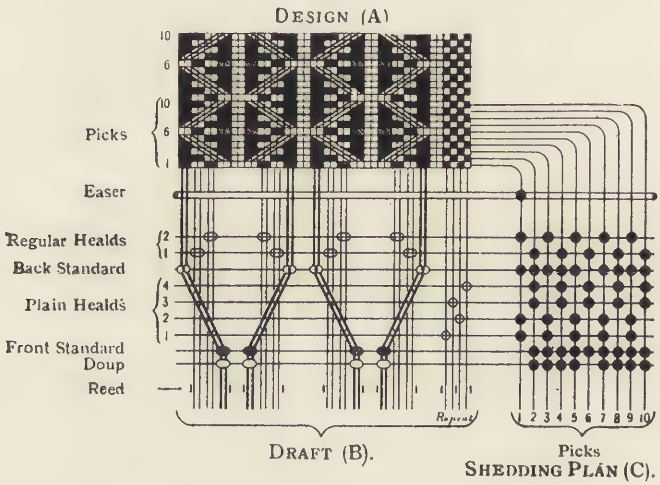


FIG. 406.—Design, Draft and Shedding Plan for Net Leno Fabric represented by Fig. 405.

is formed with a top-doup harness by raising the heald governing standard warp ends, and also the front standard; and a cross shed is formed by raising the back standard controlling doup warp ends, and also the heald governing standard warp ends, and, at the same time, slackening doup warp ends to prevent excessive strain upon them.

§ 93. Fig. 405 represents an example of net leno weaving by means of only one set of doups. In that example, a net leno stripe is developed at regular intervals, from four pairs of white doup warp ends drafted alternately to the right and left of their

respective standard warp ends, which latter consist of fine threads taped in pairs. The intervening stripes consist of the plain or calico weave, on which a spotted effect is developed by means of extra picks of coarse white weft. These float loosely underneath the leno stripes, whence they are subsequently cut away, as seen in the corner turned down. The design, with the draft and shedding plan for that cloth, are respectively indicated at A, B and C, in Fig. 406. (Horizontal lines in the drafts and

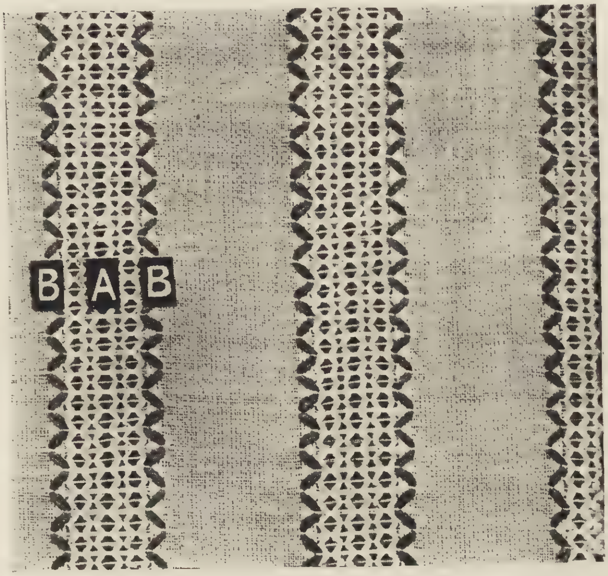


Fig. 407.—Two-doup Net Leno Fabric, for which the Design, Draft and Shedding Plan are given in Fig. 408.

shedding plans represent healds; vertical lines in the drafts represent warp ends; and a circle placed on an intersection of a warp end and heald indicates that such warp end is drawn through such heald. Vertical lines in the shedding plan represent picks of weft; and a black spot placed on an intersection of a heald and pick signifies that such heald is raised for such pick.) For simplification of the shedding plan, the spotting with extra weft, in the present example, is left out of consideration. By carefully studying the design, draft and shedding plan of each of

the accompanying examples of leno fabrics their construction will not be very difficult to understand. The action of the

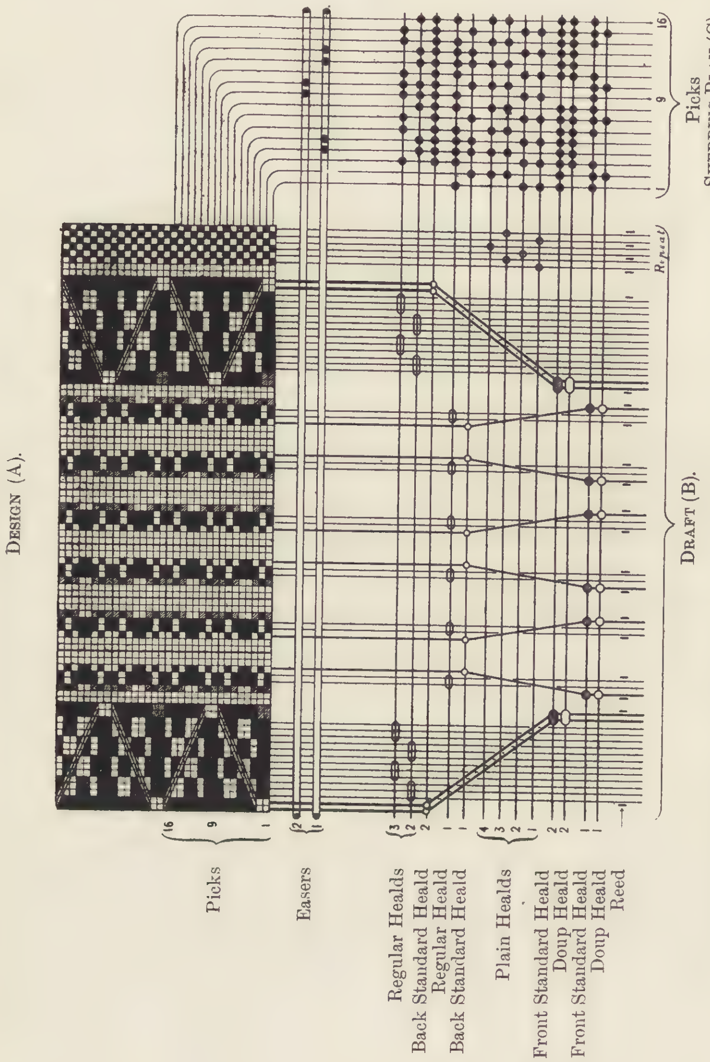


Fig. 408.—Design, Draft and Shedding Plan for Net Leno Fabric represented by Fig. 407.

healds for each pick of weft may be seen by tracing them individually from the design to the shedding plan.

For the general guidance of students it may be stated that with a top-doup heald harness, a cross shed is formed (in respect of any one series of doup threads) by raising standard and doup warp ends together, by means of their respective regular healds and back standards, whilst the same doup threads are held down in front by means of their front standard and doup healds; at the same time, doup warp ends are slackened by

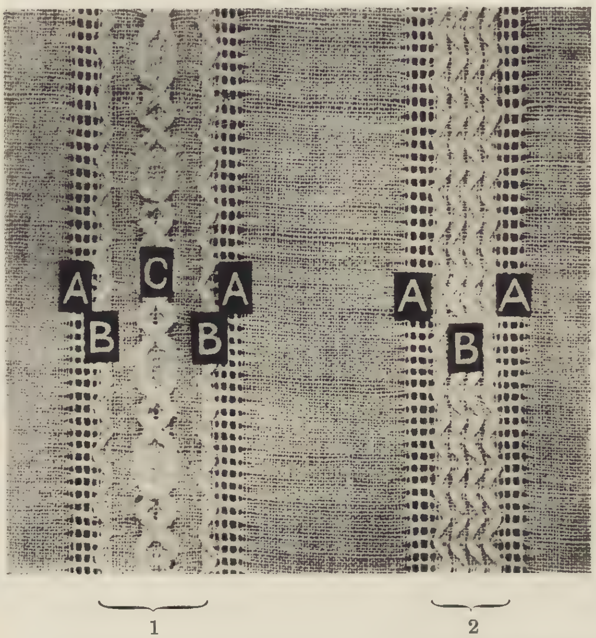


Fig. 409.—Three-doup Net Leno Fabric, for which the Design, Draft and Shedding Plan are given in Fig. 410.

means of their easers, to prevent undue strain upon them whilst making a cross shed. An open shed is formed by raising front standards (as indicated by shaded squares in the designs), with such standard warp ends as are required, and, at the same time, leaving doup healds down. (The object of raising a front standard heald without its corresponding doup heald is to liberate doup warp ends so that they may return to the normal side of their respective standard warp ends.) When a doup thread is

required at any time to pass over one or more than one pick of weft, it must be raised for such pick or picks by means of the

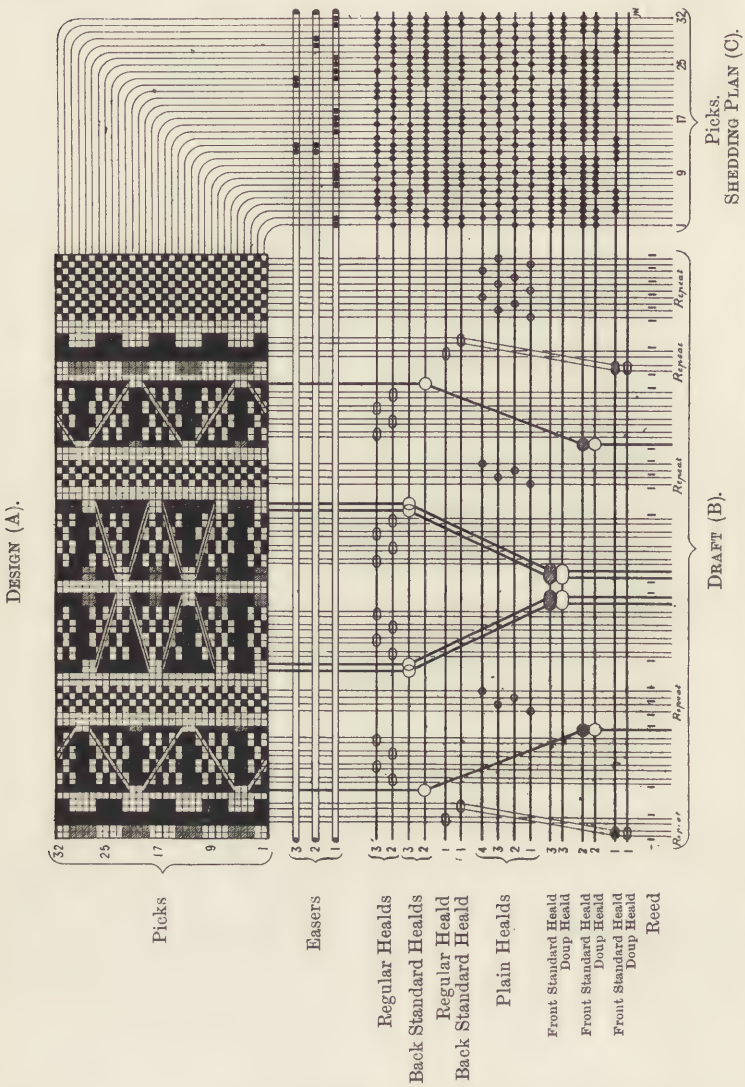


Fig. 410.—Design, Draft and Shedding Plan for Net Leno Fabric represented by Fig. 409.

front standard and doup healds, as well as by the back standard heald, *both at the same time.*

§ 94. On examining the accompanying drafts it will be observed that the dents of the reed are not of uniform width, and also that some dents are left empty. It frequently becomes necessary to remove reed wires, to obtain wider dents to receive doup and standard warp ends—when these are in such quantity as to prevent their free movement or passage (during shedding) within a dent of normal width, which would chafe and break them as the sley oscillates to and fro. Also, dents of the reed

FIG. 411.—Three-doup Compound Net Leno Fabric, for which the Design, Draft and Shedding Plan are given in Fig. 412.

are sometimes left empty to permit of net doup threads spreading in cloth, and also to accentuate the perforations characteristic of many leno effects, as exemplified in stripes A, Fig. 407, and stripes B, Fig. 411.

Fig. 407 illustrates an example of a two-doup net leno fabric, of which the design, draft and shedding plan are given in Fig. 408. One set of doups are required to produce stripes A, and another set to produce stripes B. Stripes A consist of a neat open network, caused by the reverse drafting of six doup

threads, each of which crosses two taped standard warp ends. Stripes B consist of a pair of doup threads, which cross over twelve standard threads (taped in threes) to produce a continuous wave line.

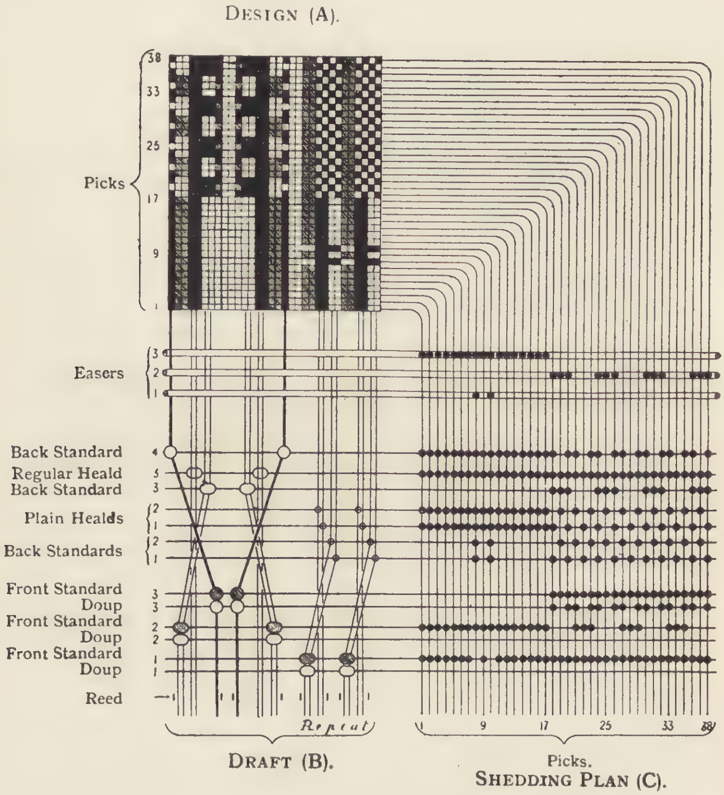


Fig. 412.—Design, Draft and Shedding Plan for Compound Net Leno Fabric represented by Fig. 411.

Figs. 409 and 411 illustrate examples of leno fabrics, each requiring the use of three sets of doups to produce net stripes A, B and C respectively. That number of doups is rarely exceeded in one loom, owing to the complications to which they give rise by the addition of numerous accessories, and the diffi-

culty of obtaining good and clear warp sheds during weaving. The construction of the fabric represented in Fig. 409 is clearly indicated in the accompanying design, draft and shedding plan (Fig. 410), which it will well repay a student to carefully investigate.

Fig. 411 is a check leno fabric of special interest, inasmuch as it embodies an uncommon feature in leno weaving. This consists of a compound leno effect produced by causing a thick net doup thread to cross from side to side of other doup and standard threads, which, combined, constitute the standard threads for that net doup thread. By carefully examining the design, draft and shedding plan (Fig. 412) for that cloth, and following the operation of the healds for each pick of weft, its construction will be easily understood. The same course should be pursued with each of the preceding examples, paying special attention to the method of drafting, and the operation of doup healds, front and back standard healds, and easers.

Gauze and Net Leno Figuring by Means of Several Back Standard Healds to each Doup Heald.

§ 95. In § 92 it was stated that, for the production of *typical* net leno fabrics, as represented by the foregoing examples, the number of doup healds, front standards and certain other essential equipments of a leno loom, must necessarily correspond with the number of different schemes of interweaving the respective doup threads in the same fabric; and, also, that the number of doup healds in one loom rarely, if ever, exceeds three. Under certain conditions, however, it is possible to develop gauze and leno effects of a more or less ornate character by means of only *one* doup heald, and *one* front standard, that operate in conjunction with any practicable number of back standard healds to govern doup warp ends, and with a corresponding number of regular healds to govern standard or regular warp ends. Or, the scope of this type of leno harness may be increased by employing more than one doup heald, each to operate in conjunction with a distinct set of back standard healds of any practicable number. It is doubtful, however, if

more than two doup healds could be satisfactorily employed with this arrangement of doup harness. Patterns developed by this system are frequently so elaborate as to give the impression that they have been produced by a Jacquard machine, or of a quite impracticable number of doup healds.

Of course this system of leno weaving imposes certain limitations in respect of the style or character of "douping" that are not existent with the use of independent doup healds. For example, *all doup warp ends* must necessarily cross from the normal or open side to the crossed side of their respective standard warp ends *simultaneously, since they are all controlled by the same doup heald;* but they may be raised either on the normal or open side of standard threads, or left down (on certain picks only) in practically any pre-determined manner. The system also virtually demands the crossing of warp ends in some definite and uniform manner at regular intervals of picks. Indeed, in one variety of this class, in which single threads cross each other to form a true gauze figure on a ground of the plain weave, or *vice versâ*, such conditions are inevitable; but in another variety, in which comparatively thick net doup threads are introduced solely as a means of embellishment, the restrictions are not quite so confined.

Leno fabrics of the class under present notice are of three distinct varieties, namely: (1) those in which a gauze figure is surrounded by the plain or tabby weave (or *vice versâ*), and in which warp ends cross each other as single threads, with one pick in each shed, as illustrated at C, Fig. 413; (2) those in which either warp or weft is allowed to float freely (for the development of brocade figuring), but which in all other respects are like (1); and (3) those in which *net leno* figuring is developed by means of thick net doup threads upon a comparatively light ground texture, preferably of the plain calico weave.

Although it is for many reasons (as subsequently explained in § 107) more expedient to weave *net leno* fabrics of the ordinary type by means of a *top-doup* harness, that arrangement is perhaps not so well suited as a bottom-doup harness to the production of the class of leno fabrics under present consideration, chiefly because the formation of a cross shed with a harness of

this type would require *all healds* (excepting the front standard and doup healds) to be raised. Still, when that course would not involve excessive straining and risk of breakage of mechanical parts, nor absorb an abnormal degree of motive power, it would be advisable (if other circumstances were favourable), to employ a top-doup harness in preference to a bottom-doup harness. It should be carefully observed, however, that the accompanying drafts and shedding plans for this variety of leno fabrics are all arranged for *bottom-doup* harnesses.

§ 96. The construction of the first-named variety of this class of fabrics is illustrated in Fig. 413, where A and B respectively show the method of drafting and shedding to produce cloth represented at C, in accordance with the design given in Fig. 414. This is a simple pattern, repeating on twelve warp ends and picks, developed by alternating diagonal bands of the gauze and calico weaves, and will serve to demonstrate the principles on which they are designed and woven.

As indicated in the draft at A (Fig. 413) warp ends are drawn through twelve healds with a straight-over draft. After passing through those healds in regular succession, alternate warp ends, that are passed over an easer, are taken as doup threads (represented by white lines), which, after crossing *underneath* from left to right of the intermediate warp ends (which become standard threads, represented by black lines), are passed through the loose slips of the doup or half-heald which hang underneath warp ends, as previously described and illustrated in § 90. Thus: healds Nos. 1, 3, 5, 7, 9, 11 become back standards to govern doup threads; whilst healds Nos. 2, 4, 6, 8, 10, 12 are regular healds to govern standard warp ends.

§ 97. It is characteristic of this particular variety (1) of leno fabrics that *all* doup threads, and those only, are invariably raised by the front standard and doup healds for alternate (say even-numbered) picks to form cross sheds; but both doup *and* standard threads may be raised for intermediate (or odd-numbered picks) to form open sheds, according to the pattern required; care being taken not to raise, *at the same time*, fellow doup and standard threads that cross each other, and pass through the same dent of the reed. Thus, where it is required to form

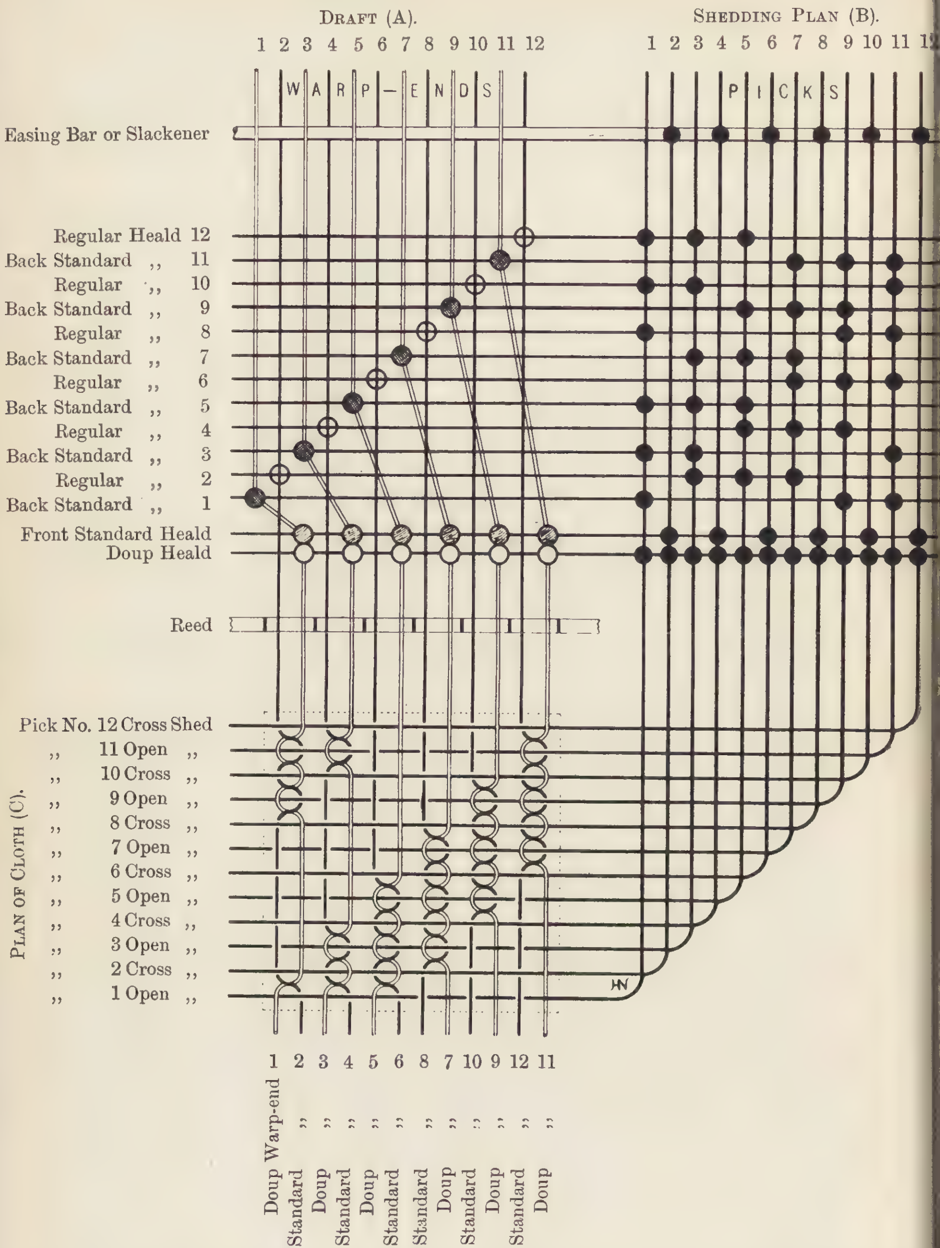


FIG. 413.—Graphic Diagram to demonstrate the Production of Figured Gauze and Leno Fabrics, by means of One Doup and One Front Standard Heald operating in conjunction with more than One Back Standard Heald. The Shedding Plan indicated at B, with the Draft A, would produce the Pattern represented in the Plan of Cloth, C, in accordance with Design Fig. 414.

gauze, doup threads are raised by their respective back standards; whilst in the calico portion standard threads are raised by their respective healds *for odd-numbered picks only.* The operation of healds in this manner gives rise to a peculiar phenomenon in cloth which is, at first, very puzzling to those who are more or less intimately acquainted with leno fabrics constructed in the usual manner. An examination of the plan of cloth will show that doup threads *appear to form an open shed* when raised on the *right* of their respective standard threads, whereas they are actually forming a cross shed, and *vice versâ.* This apparent anomaly arises in consequence of employing only one doup heald *which must rise for alternate picks* to develop the plain weave in observance of the principles governing the construction of these fabrics. It should also be observed (*a*) that the easer must slacken doup threads whenever both front standard and doup healds are raised together to form a cross shed —that is, on alternate picks; and (*b*) that the doup heald must lift *without* the front standard on intermediate picks. The reason for raising the doup heald without the front standard, when an open shed is formed, is to liberate *all* doup threads, and permit of the required doup threads being raised on the normal side of their respective standard threads by means of their back standard healds. It will now be evident why a bottom doup harness is preferable to a top-doup harness for weaving these fabrics. If the latter were employed to weave design, Fig. 414, the shedding plan B (Fig. 413), would have to be entirely reversed in all parts excepting the easer, and such a course would necessitate much greater power for shedding.

The chief considerations affecting the construction of these fabrics are clearly indicated in the plan of cloth at C, which should be carefully studied in conjunction with the design (Fig. 414), draft at A, and shedding plan at B. This may best be accomplished by comparing each pick in the design with the corresponding picks in the shedding plan; and by tracing the lines (representing picks) from the shedding plan to the corresponding picks in cloth, and thereby trace the cause to the effect. The preparation of designs for these fabrics will be greatly facilitated by using design or point paper on which the

narrow divisions, in one direction, are ruled off in pairs, with lines of medium thickness, as seen in Fig. 414. The two narrow divisions between two medium lines correspond to a doup warp end and its fellow standard warp end that cross with each other and pass through the same dent of the reed. Such a course will reduce the risk of a designer inadvertently raising two fellow warp ends at the same time, which would not be in strict

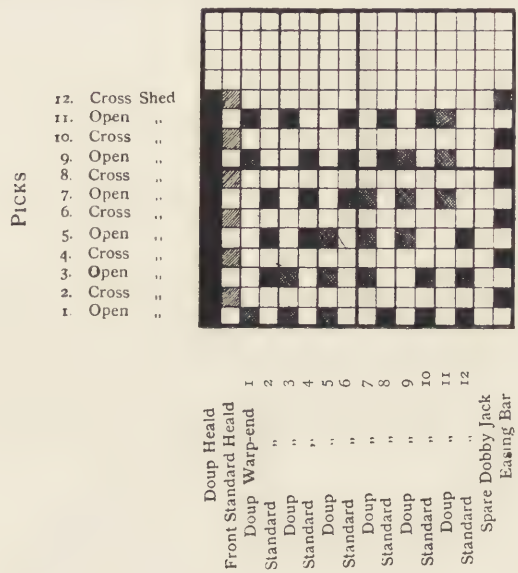


FIG. 414.—Design for Pattern represented in Graphic Plan of Cloth, C, Fig. 413.

accordance with the principles governing this particular variety (1) of the class of fabrics under present consideration.

§ 98. In §§ 95 and 96 it was described how the simple gauze and plain calico weaves could be combined to develop simple figured effects by means of only one doup heald and a front standard heald, operating in conjunction with several back standard and regular healds, to produce the first-named variety (1) of this class of leno fabrics, as illustrated in Fig. 413. The second variety (2) of this class are characterised by *warp-float*

figures on the obverse side, and *weft-float* figures on the reverse side of cloth (when in the loom), either in combination with the simple gauze weave only, or with both that and the plain calico weave. It should be noted, however, that in observance of the principles governing the construction of these fabrics, *doup* warp ends may only be allowed to float on that side of their fellow standard warp ends to which they have been crossed in the shedding harness, and *not* on the normal or open side of those threads. The reason for this will be understood when it is remembered that all doup warp ends must necessarily be raised on their crossed side of standard warp ends by means of the front standard and doup healds, for alternate picks of weft, as required for the development of the gauze and plain weaves; but where warp figure is required, standard warp ends also may be raised in those parts for the same picks. For the intermediate picks, therefore, *doup* warp ends must be *raised* in the float or brocade figure and gauze portions only, by means of their respective back standard healds; but they must be *left down* in the *plain weave;* also, *standard* warp ends must be *raised* in the brocade figure and plain weave portions only, but *left down* in the *gauze* portion, for the same picks. When those picks are inserted, the doup heald is raised, in order to liberate *all* doup warp ends, and permit such as are required up to be raised by their respective back standard healds. It should be explained, that, although doup warp ends may be raised (for the intermediate picks) on the normal side of standard warp ends, by means of their back standard healds, in order to develop brocade figuring, they will not remain on that side in the cloth, but will be pulled to the crossed side (when raised for the alternate picks) by means of the front standard and doup healds, and permanently remain there, as described in § 97. Doup threads are enabled to return to their crossed side in the brocade figure portions, in consequence of both standard and doup warp ends being *raised together* in those portions, and not intersecting with weft. When preparing designs for this variety of leno fabrics, it is advisable, in order to obtain the best results, to always separate warp figure from gauze by a margin of the plain or calico weave, as illustrated in the design, Fig. 415, in

which shaded squares represent the gauze weave. The shedding plan for that design, given in Fig. 416, is adapted for a bottom-doup harness similar to that represented in diagram Fig. 413, but consisting of eight back standard and eight regular healds, with a front standard and a doup heald, and an easing bar. By studying Figs. 415 and 416 in conjunction with that diagram, the foregoing description will be more easily comprehended. It should be observed that these two varieties of leno fabrics impose certain restrictions with regard to the method of drafting warp ends through the healds, namely: Doup and standard threads must be arranged in the harness *alternately* with each other,

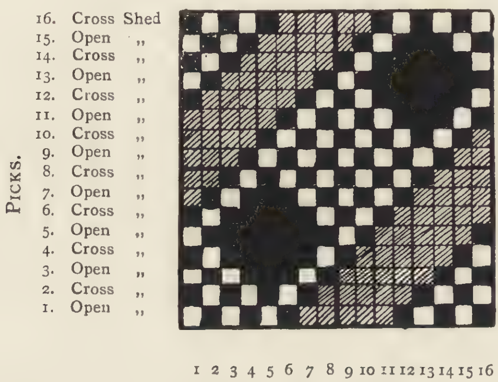


Fig. 415.—Design for Figured Gauze Fabric, for which the Shedding Plan is given in Fig. 416.

and with doup threads crossing their fellow standard threads uniformly in the same direction, when passing from their respective eyes in the back standard healds to their appointed doup slips in the doup heald. These conditions are necessary in order to effect the combination of true gauze with the plain or tabby weave, which characterises these fabrics. Also, their construction does not permit of the employment of "pointed" or "centred" drafts that are obtained by simply reversing in the usual manner. This arises in consequence of warp ends being in *pairs*, each of which consists of a doup and a standard thread that are complementary to each other and operate in conjunction

in the gauze and calico portions of the fabric, and not as independent threads.

§ 99. By far the most useful and interesting variety of this type of figured leno fabrics is that constituting the variety (3), in which "net leno" figuring is developed upon a comparatively light muslin texture, as exemplified in the accompanying reproductions of cloth (Figs. 417, 419, 421 and 422). This variety (3) of leno fabrics is of a distinctly different character from any

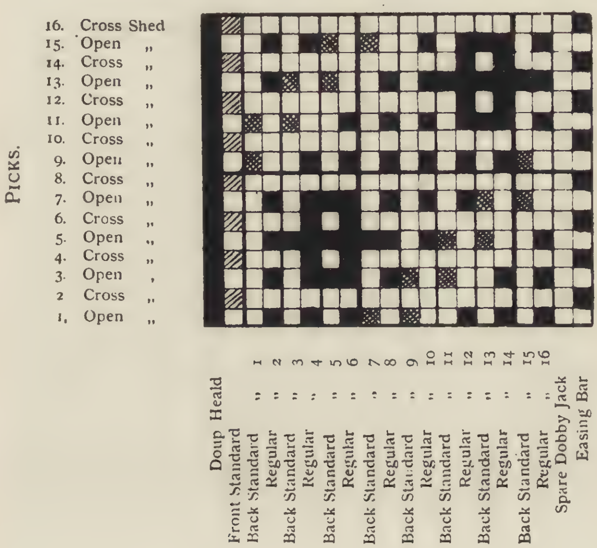


FIG. 416.—Shedding Plan for Design given in Fig. 415.

that have been previously described, and affords much greater scope to a designer in the production of decorative effects. Also, it imposes fewer restrictions in the construction of designs than are imposed by the varieties of one-doup leno fabrics (1 and 2). This arises from the employment of comparatively thick "net" doup warp ends for figuring purposes only. These work quite independently from the fine ground warp ends, and play no part whatever in the construction of the foundation texture. They

may, therefore, be employed in greater or lesser numbers in relation to ground warp ends, and may be disposed either in groups to produce stripes (as in Fig. 417), or at regular intervals and short distances apart, for the development of all-over patterns. All doup warp ends are controlled by one doup heald and a front standard heald (for the formation of cross sheds) and such number of back standard healds (to form open sheds) as corresponds with the different orders of interweaving doup

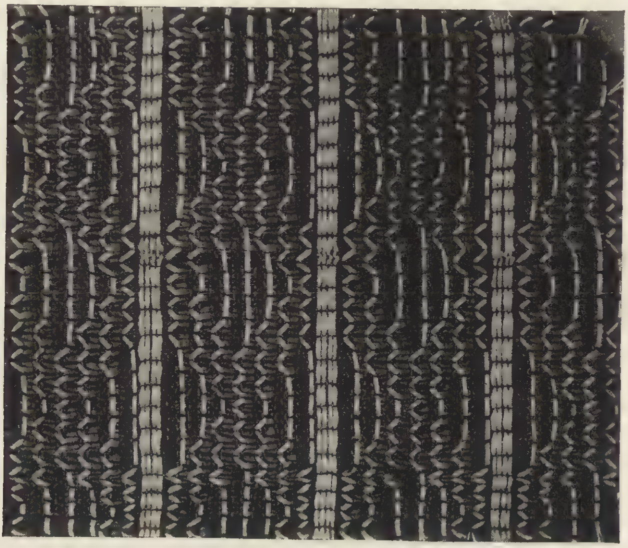


FIG. 417.—Net Leno Fabric woven by means of One Doup and One Front Standard Heald, and Four Back Standard Healds, for which the Design, Draft and Shedding Plan are given in Fig. 418.

threads with the ground texture. It is imperative, therefore, that doup warp ends must "doup," *i.e.*, be raised on their crossed side to form cross sheds, *simultaneously*, although they may be either raised or left down by their respective back standards, for the open sheds; hence only one easing bar is required to slacken all doup warp ends simultaneously during the formation of cross sheds. Provided designs are constructed to ensure a uniform rate of contraction by all doup threads, the latter may be contained on one warp beam; but if their rate of contraction varies,

they will require to be wound upon separate beams, according to the different rates of contraction. Ground warp ends are governed by healds placed in the rear of back standard healds, and are contained upon a separate warp beam.

Doup threads may be crossed under their respective standard or ground warp ends (in the shedding harness) in almost any desired manner, either in the same direction, uniformly, or in reverse directions, as required, In the example of cloth represented in Fig. 417, white mercerised doup threads of twofold yarn are arranged in groups to form stripes. Each group consists of seven pairs of threads, all of which cross their standard warp ends in the same direction in the harness, with each pair of doup threads crossing three pairs of black ground warp ends that are intersected with black weft to produce a light muslin foundation texture. The leno stripes are separated by a white stripe composed of four pairs of white mercerised threads of the same material as doup threads.

The method of designing and drafting for this variety of leno fabrics is demonstrated in Fig. 418, which shows the design, draft and shedding plan at A, B and C respectively, for the production of the example of cloth represented in Fig. 417. The pattern repeats on sixty-three warp ends (counting each pair of white mercerised threads as one) and sixty picks of weft. Warp ends would require to be wound upon three warp beams, namely, one for ground threads, one for doup threads, and one for the white threads to form the narrow stripes. The shedding harness comprises a doup and a front standard heald, four back standard healds, two healds to govern ground warp ends, two healds to govern black warp ends to weave plain cloth in the narrow stripes, and one heald to control the threads forming the narrow white stripes.

§ 100. It is important at this particular stage to remind readers that if net leno fabrics are produced by means of a *bottom-doup* harness, they will be woven face downward. This warning is necessary to prevent confusion by the apparent inconsistency between the cloths, as here represented, and their respective designs, which latter, being prepared for bottom-doup harnesses, represent the reverse side of cloth. The dotted lines

on the design (Fig. 418) are not essential to its construction, but are merely introduced to indicate doup warp ends as they will appear on the *face* side of cloth, so that their working may be easily followed. On examining that design and shedding plan, it will be seen that a cross shed is formed for two con-

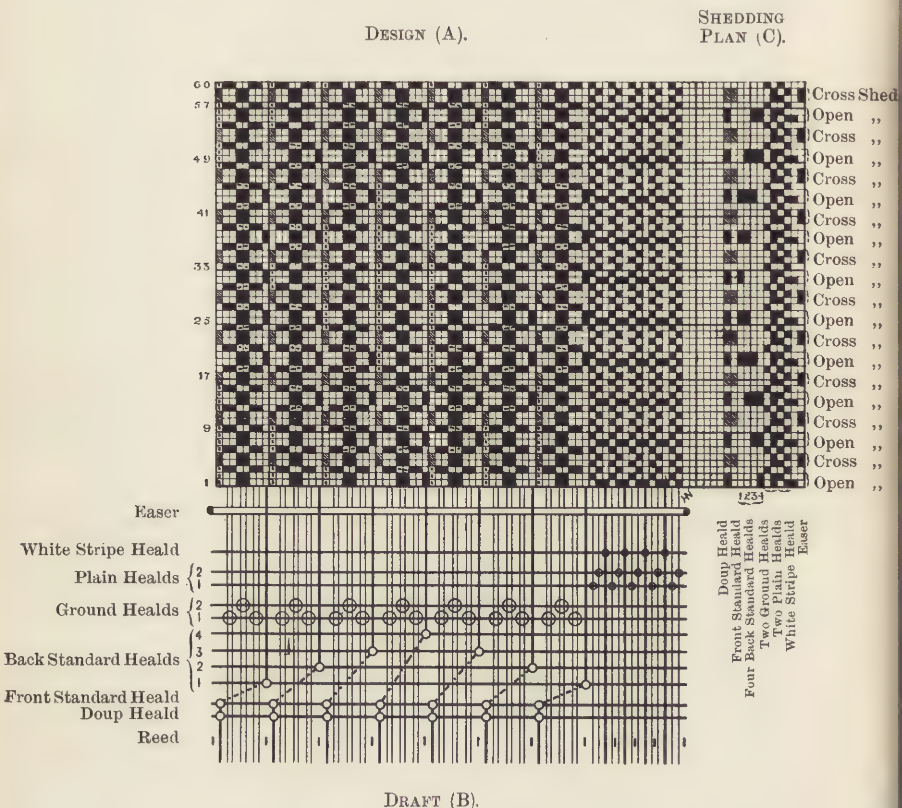


Fig. 418.—Design, Draft and Shedding Plan for Net Leno Fabric represented by Fig. 417.

secutive picks out of every six, by raising the front standard and doup healds, and slackening the easer; whilst the ground healds operate as indicated. The two consecutive picks midway between those in the cross sheds are inserted in *open sheds*, for which doup warp ends may be either raised or left down by

their respective back standard healds, as required. When, however, the single picks of weft, that intervene between those in the cross and open sheds, are inserted, *all doup warp ends must remain down.* The peculiarity of these fabrics (that was referred to in §§ 97 and 98) of doup threads appearing to be on the normal side of standard warp ends, when they are actually on the crossed side of those threads, and *vice versâ*, is also observable in this variety of leno fabrics.

§ 101. Figs. 419 and 422 are reproductions of other examples of figured "net leno" fabrics in which the figuring is developed by means of only one doup and one front standard heald,

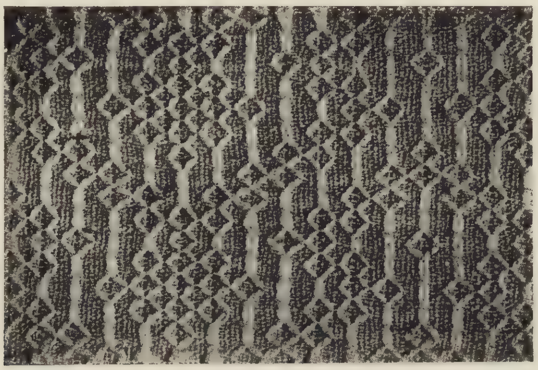


FIG. 419.—Net Leno Fabric, woven by means of One Doup and One Front Standard Heald, and Five Back Standard Healds, for which the Design, Draft and Shedding Plan are given in Fig. 420.

operating in conjunction with several back standard healds, and two or more healds to govern ground warp ends to produce the foundation texture. In these examples doup warp ends are arranged in pairs disposed at regular intervals apart, for the production of all-over designs. The threads of each pair cross their respective standard ground warp ends in reverse directions, so as to develop a neat diamond formation, excepting where doup threads lie straight and parallel on their *crossed* side of standard warp ends. The present examples will serve to indicate the general character of designs suitable for these fabrics, and also the fair scope they offer to a designer in the creation of

effective patterns. The example of cloth represented in Fig. 419 has a foundation texture of the plain weave, consisting of fine ground warp ends (taped in pairs) picked with fine weft. Doup warp ends, of two-fold yarn, each cross three pairs of standard threads, and are governed by five back standard healds, in addition to a front standard and a doup heald. It has required a different drafting of doup threads through the back standards, but not of ground warp ends, which are governed by two healds that rise and fall alternately for consecutive picks throughout.

The design, draft and shedding plan (arranged for a bottom-doup harness) required to weave the example of cloth (Fig. 419) are given at A, B and C respectively (Fig. 420). The pattern repeats on eighty-four pairs of ground warp ends (represented in the design and draft as single threads) and twenty-eight doup warp ends and sixty-four picks of weft. Doup warp ends are drawn through the back standards so as to form a reversed pointed draft. The method of drafting doup warp ends for these examples of cloth marks a distinctive and important feature of interest in their construction. As will be seen, on consulting the draft (B, Fig. 420), doup warp ends are disposed in pairs, with the two threads constituting a pair crossing from their normal to their crossed side in reverse directions simultaneously, and drawn through heald eyes in the same back standard. For example, the central pair of doup threads are drawn through the fifth back standard heald, and constitute one extreme point of the draft; whilst the first and last doup threads in the pattern, which cross in reverse directions, both pass through the second back standard, and constitute a pair forming another point in the draft.

This arrangement of the draft causes the threads of each pair to converge and lie side by side, quite straight and parallel with each other, *when on their crossed side*, but to diverge when raised by their back standard healds. Thus, by forming cross and open sheds at regular intervals (of picks) apart, the neat net leno diamond formation, characteristic of the present examples, is produced. On examining the design and shedding plan, it will be observed that an *open shed* is formed for two contiguous picks (the third and fourth) out of every eight picks, and a *cross*

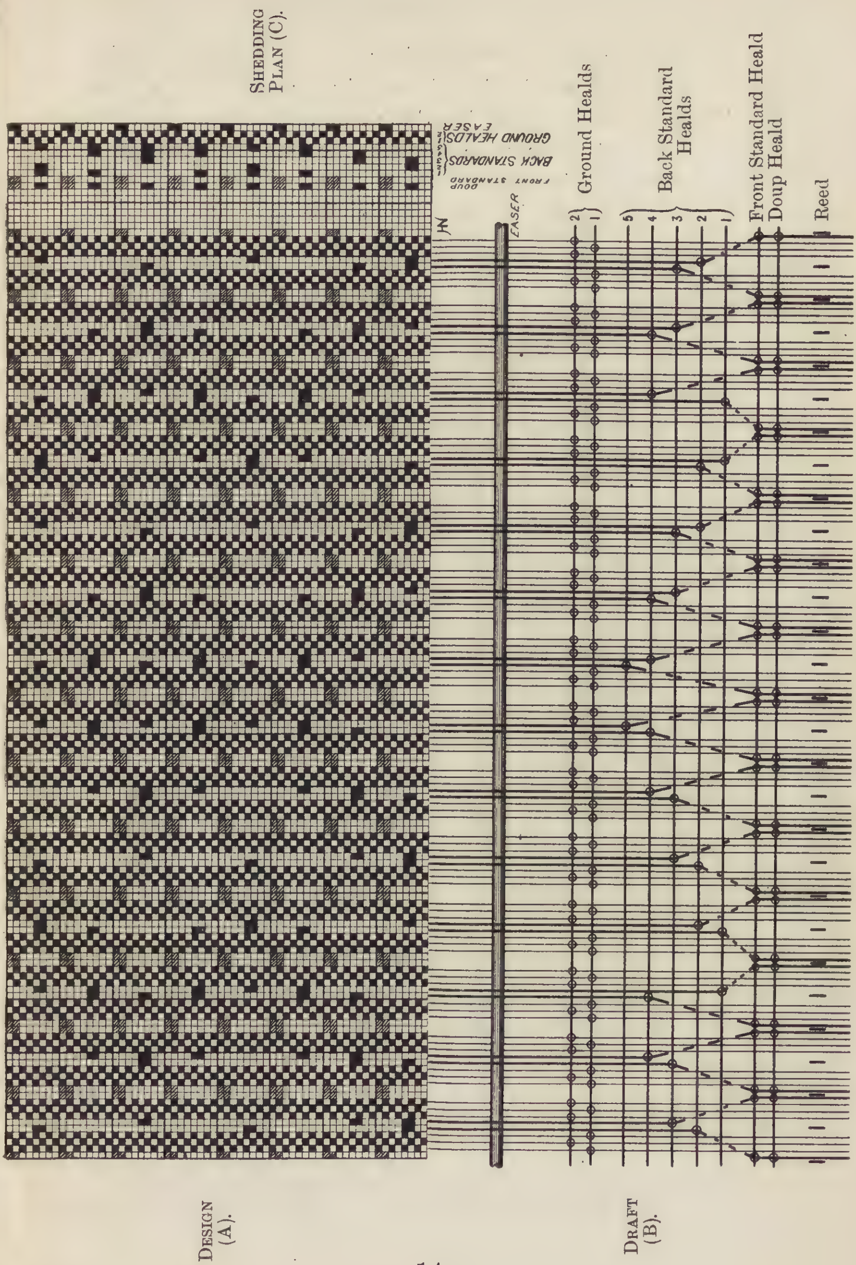


FIG. 420.—Design, Draft and Shedding Plan for Net Leno Fabric represented by Fig. 419.

shed for the intermediate pairs of picks (the seventh and eighth), whilst the ground healds rise alternately for consecutive picks throughout, to produce the foundation texture. Owing to the different rates of contraction of doup warp ends, with this design, those threads will require to be contained upon three separate warp beams, in addition to one containing ground warp ends.

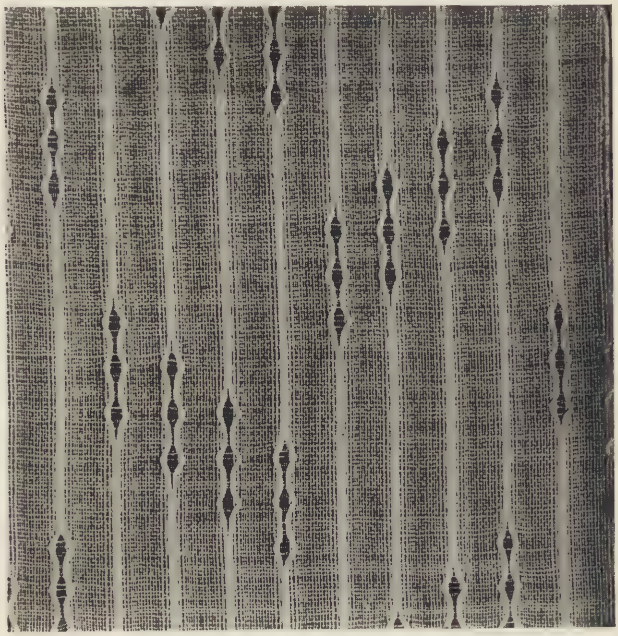


FIG. 421.—Net Leno Fabric, woven by means of One Doup and One Front Standard Heald, and Eight Back Standard Healds.

§ 102. The cloth represented in Fig. 421 shows a slight variation from the previous examples in having doup warp ends more widely dispersed upon a muslin ground texture of plain cloth. In this example, each set of doup warp ends consists of two pairs of threads of two-fold yarn, crossing their respective standard warp ends in reverse directions. The ground warp ends, which serve as standard threads for each doup warp end,

consist of four threads taped in pairs, whilst the intervening stripes of plain cloth consist of eleven single warp ends. This example has required eight back standard healds to produce the pattern which it contains, with consecutive pairs of doup threads drawn through them in regular succession to form a straight-through draft. The leno effect is developed by forming two cross sheds in succession, for single picks, at intervals of six picks, and by forming an open shed, where required, also for

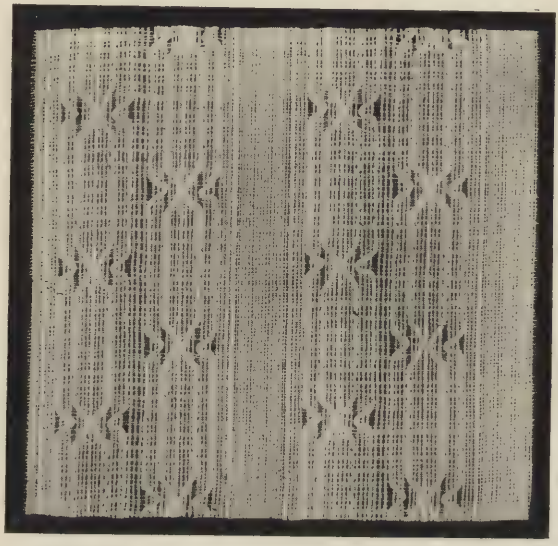


FIG. 422.—Net Leno Fabric, woven by means of Two Doup and Two Front Standard Healds, with Two Back Standard Healds operating in conjunction with each Doup Heald, and its Front Standard Heald.

single picks, midway between two cross sheds, but only at intervals of twelve picks; thus: **1** (*cross shed*), 2, 3, 4, 5, 6, **7** (*cross shed*), 8, 9, **10** (*open shed*), 11, 12, and so on. It is imperative, in order to create harmonious leno effects in fabrics of this variety, that cross and open sheds should be formed in a rhythmical order, and not at irregular intervals of picks apart. It may also be observed that if doup warp ends cross their standard threads in the same direction uniformly (as in Fig. 418), it is advisable to draw them consecutively through successive

back standard healds; but if they cross in reverse directions (as in Fig. 420), they should be drawn through the back standards in pairs, as indicated in the draft (B).

§ 103. It was stated in § 95 that more than one doup heald, each to operate in conjunction with several back standard healds, may be employed to increase the scope of the type of leno harness under present notice. The example of cloth represented by Fig. 422 has required two doup healds, each operating with two back standards. In this example doup threads lie straight when on the *normal* side of their standard threads, as in ordinary leno fabrics. This specimen was submitted for analysis at the City and Guilds Second Year's Examination (1905) in Cotton Weaving.

Leno Specialities.

§ 104. In the production of gauze and leno fabrics by the methods previously described in this chapter, it is impossible to effect a crossing of any two or more warp ends with each other, unless the crossing threads are severally contained in the same dent of the reed: hence, a crossing may not be made with warp ends that are separated by a reed wire. This restriction, however, may be avoided by the use of specially adapted leno weaving devices, whereby the crossing of warp ends is accomplished by means of doup healds situated *between* a disappearing beating-up half-reed, or comb, and an ordinary deep stationary reed, situated *between* the doup healds and regular healds, as clearly represented in Fig. 430. Such arrangement of healds and reeds enables warp ends to be crossed either separately, or in groups, in almost any conceivable manner, irrespective of the order in which they pass through the dents of the stationary reed, during weaving. Thus, it is possible to effect a crossing of threads, *en masse*, that extend over several dents, without those threads *crossing or douping with* the intermediate warp ends which they simply pass over. The doup harness may be either a top or bottom-doup harness, or it may be a combination of both these arrangements. Also, warp ends may be passed through and governed by two separate and distinct doup slips of the same or different lengths, to effect a crossing to the

right or left over a smaller or a greater number of threads, as required. This system of leno weaving affords almost illimitable opportunities to a capable designer in the creation of decorative effects of a very ingenious and pleasing character, as exemplified in Figs. 423 to 429, which are full-size photographic reproductions from actual pieces of cloth representing a few typical examples of this particular variety of leno fabrics.

§ 105. The construction of these fabrics will be better un-

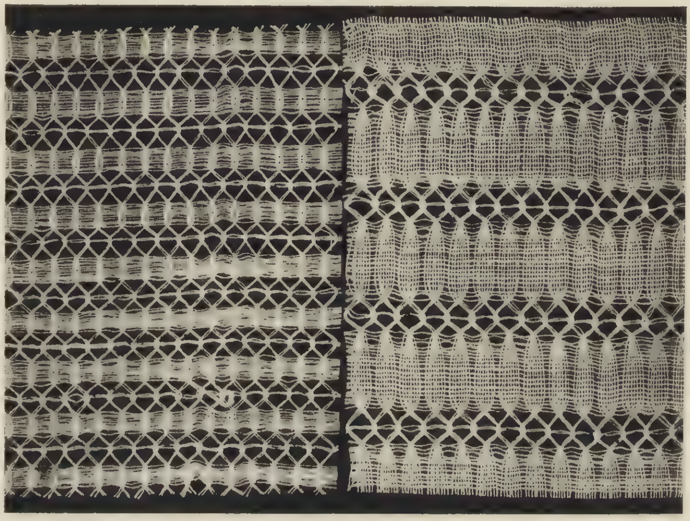


FIG. 423. FIG. 424.

Special Leno Effects produced by a system of crossing Warp Ends in front of the Reed.

derstood if the reader is informed of the mechanical devices employed in their manufacture, of which there are several modifications that differ chiefly in details of construction and operation. With the object of conveying that information to students, a diagram representing a part sectional elevation of a loom equipped with Whitehead and Wood's modification of a special leno weaving device is given in Fig. 430. With a view to better demonstrating the operation of this device, the sley and its appurtenances are represented at both the backward

and forward extremities of their movement by full lines and dotted lines respectively. As indicated in the diagram, instead of fixing a reed in its usual place in the sley, a reed O, of unusual depth, is placed between the regular healds N, and the doup healds P, and permanently fixed to brackets secured to the loom framing. The function of the stationary reed is simply to effect an even distribution of warp ends over the required

FIG. 425.

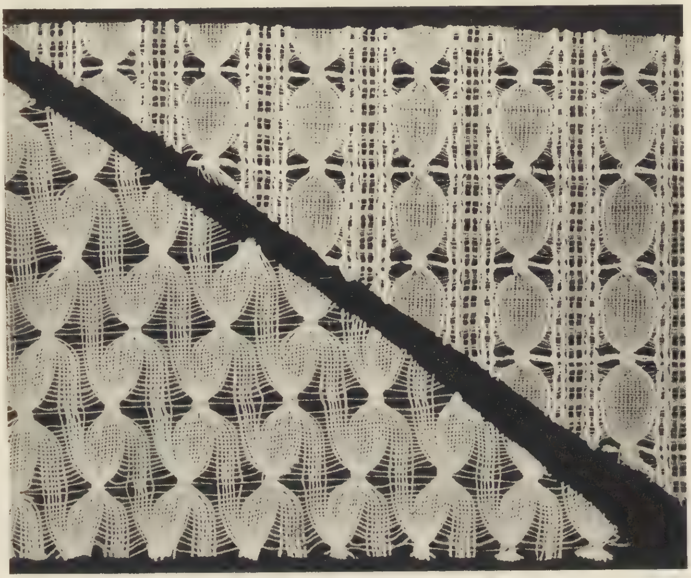


FIG. 426.

Special Leno Effects produced by a system of crossing Warp Ends in front of the Reed.

width of cloth, and to retain them at that width. Fixed at each end, and in the rear of the sley, are two iron brackets, each formed with three vertical slots to freely receive the ends of three staves extending from end to end of the sley. The foremost slot in each bracket contains a coarsely-pitched half-reed or pin-stave G, situated immediately behind the shuttle raceboard, in place of the usual reed, for the purpose of guiding a

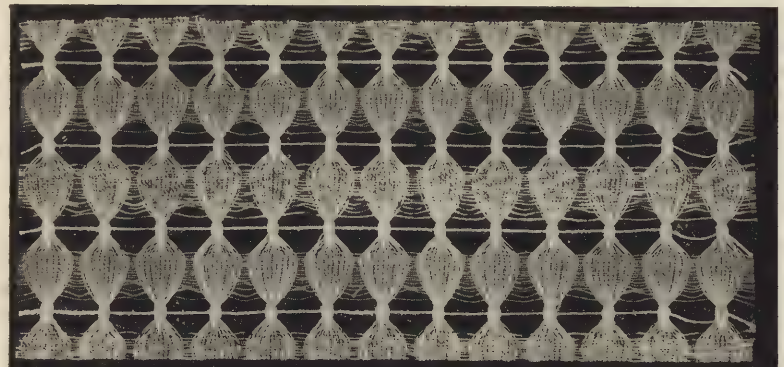


FIG. 427.

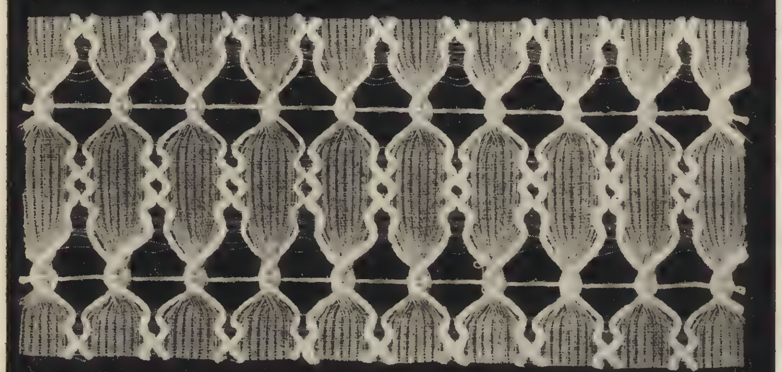


FIG. 428.

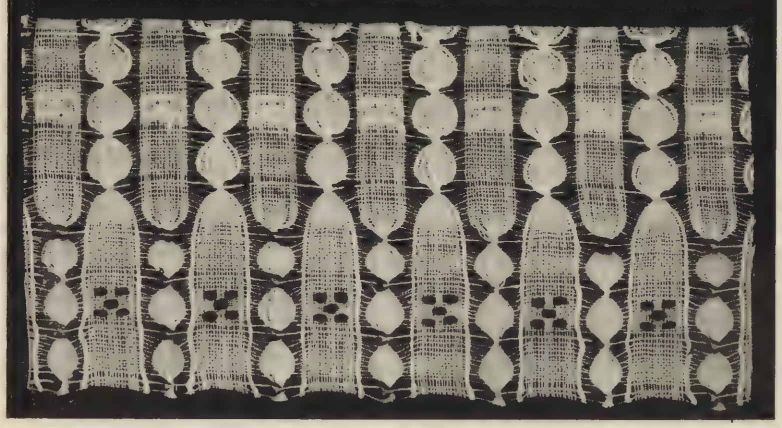


FIG. 429.

Special Leno Effects produced by a system of crossing Warp Ends in front of the Reed.

shuttle in its transit through the warp sheds. To the rear of the pin-stave is a half-reed or comb F, for the purpose of beating up the picks of weft; whilst above the half-reed is an iron locking bar J, to securely lock the half-reed, and make it rigid whilst beating up. All these parts alternately rise and fall in unison with the movement of the sley, and in the following manner, namely: As the sley advances, the half-reed rises to beat up weft, and the locking bar falls, thereby passing immediately behind the upper ends of the reed wires, to give them firmness whilst beating up. As the sley recedes, the half-reed falls, and the locking bar rises, so that both move clear of warp ends during the formation of a shed, and warp ends are thereby free to be crossed as required between the stationary reed and the "fell" of cloth. The base of the half-reed is connected by rods E, to the ends of levers C, and its upward and downward motion is effected by means of two cams B, fixed one near each end of the crank shaft A, of the loom. The cams act upon the levers C, which are each fulcrumed upon studs D fixed in the ends of arms that project from the sley swords, and, therefore, oscillate with the sley. The motion of the pin-stave G is contrary to that of the half-reed F. Thus, as the sley recedes, the pin-stave rises, to act as a guide for the shuttle as it passes through the warp sheds, but falls clear of the warp ends, cloth, and loom temples, as the sley advances to beat up weft. The contrary action of the pin-stave and half-reed enables the first to be actuated by the second, by attaching them to opposite ends of cords H, which pass over pulleys I. The upward and downward motion of the locking bar J is obtained by means of cords K, which pass over pulleys L, and have each one end attached to fixed points M, on the loom framing. Thus, as the sley advances, the cords diminish in length between the pulleys L and the fixed ends M, thereby allowing the bar to fall by gravitation; but as the sley recedes, the cords increase in length between the fixed points and pulleys, thereby raising the locking bar clear of warp ends. A similarity exists between the sley of this type of loom and that of a lappet loom, as represented in Fig. 448 (§ 123). Both are provided with pin-staves for the guidance of a shuttle during picking; but, instead

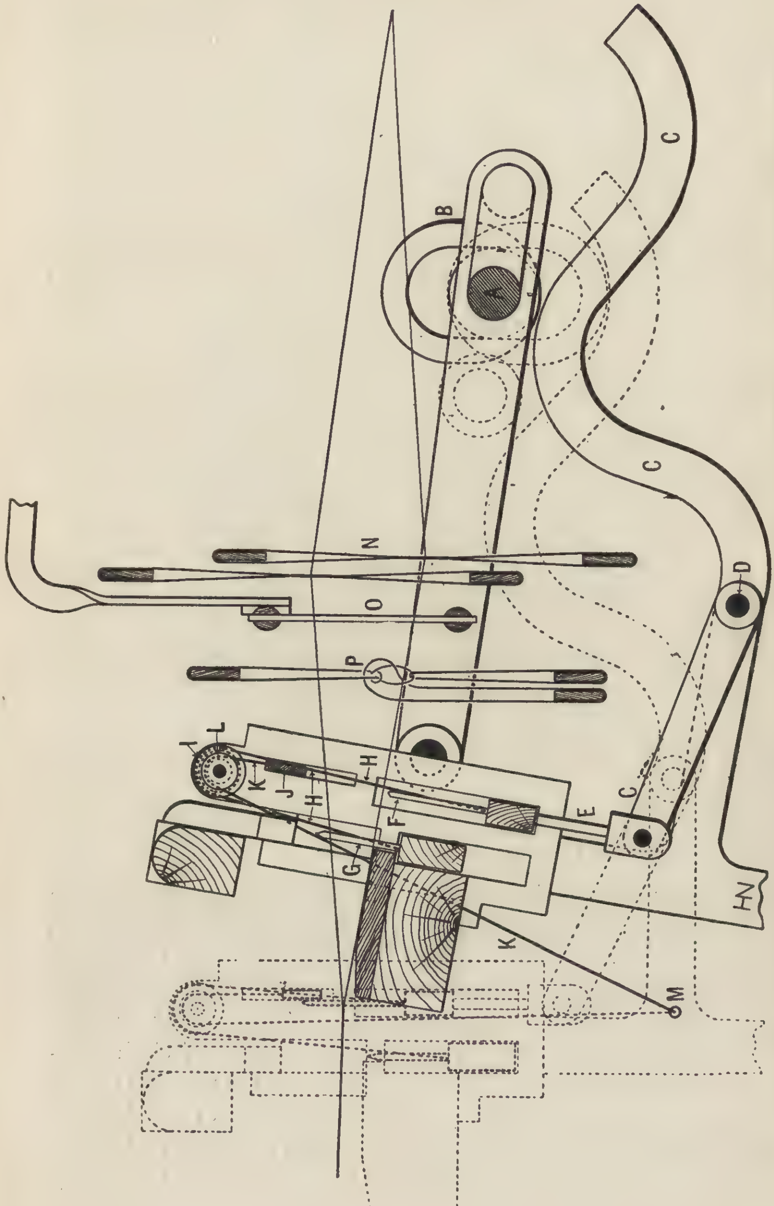
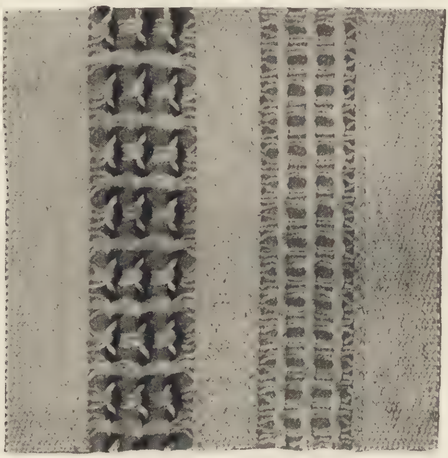


FIG. 430.—Whitehead and Wood's Device for the production of Special Leno Effects by douping or crossing Warp Ends in front of the Reed.

of a half-reed, a lappet loom is furnished with one or more needle bars to control figuring or "whip" threads, and these bars are moved laterally for figuring purposes, as well as vertically, to insert figuring threads into the warp sheds.

Full-cross Leno Fabrics.

§ 106. In all the examples of leno fabrics herein described, doup threads make only a partial or half turn around their respective standard threads: that is, they pass from one side to



A

FIG. 431.—Full-cross Net Leno Fabric in which Doup Warp Ends are twisted completely around Standard Warp Ends, at intervals of four Picks to the Right and Left alternately.

the other side of those threads, and then return to the same side, on different picks of weft, and do not completely twist around them. Sometimes, however, leno fabrics are produced in which doup threads are caused to completely encircle their standard threads, and thereby produce a full crossing or twist with them, as exemplified in an actual specimen of cloth illustrated by Fig. 431, in which pairs of black doup threads cross or twist with pairs of white standard threads, to develop the striped leno effect shown at A. This unusual system of crossing is accomplished by causing the doup slips to completely

wrap around the standard threads, as they pass from the doup threads to the heald stave on which they are contained. Thus, whenever a shed is formed, whether it be an open or a cross shed, the doup threads are either up or down *always on the same side* of their respective standard threads; thereby causing them to make a full crossing, as described.

Relative Merits of a Top and a Bottom Doup Harness.

§ 107. Throughout this chapter frequent reference has been made to the alternative methods of placing doup slips *above* or *below* warp ends, for the production of gauze and leno fabrics, both of which systems are described in § 90. Since the choice of position is quite arbitrary, it is not surprising that the opinions of practical men, respecting the relative advantages of both systems, should vary according to their prejudices and varied experiences, and that some advocate one system and some the other. From this circumstance, it is quite evident that each method possesses some advantage over the other, at least for certain classes of fabrics; otherwise, one of the two would long since have been discarded in favour of the better system. It will, therefore, be both interesting and profitable to briefly compare the relative merits of each system, and to state which it may be more expedient to adopt, under different circumstances.

For the production of net leno and similar fabrics containing thick net doup threads or cords, that are chiefly displayed on one side of cloth, it is more expedient to employ a top-doup harness. By that arrangement, such fabrics are woven face side upward, thereby enabling a weaver to more readily detect imperfections in cloth during weaving. Another great advantage to a weaver, of doups being placed above warp ends, is that they are more accessible and therefore more easily repaired, or else replaced by new ones, which frequently becomes necessary, in consequence of doup slips rapidly wearing out. In the event of breakages, however, top-doup slips are liable to prove a source of serious trouble to a weaver by hanging down and becoming entangled with warp ends, thereby involving the risk of breaking them, and causing faults in cloth. Another disadvantage of

top doups is in respect of shedding. If a negative acting dobby and a spring under motion are employed to operate a top-doup harness, it is more difficult to obtain a good lower half of the warp shed, in consequence of healds being depressed and held down negatively, by means of springs. This arises in consequence of the abnormal tension of doup warp ends during the formation of both cross and open sheds, whereby they tend to rise a little above the surface of the shuttle race-board, instead of lying well down upon it, as a shuttle is transmitted

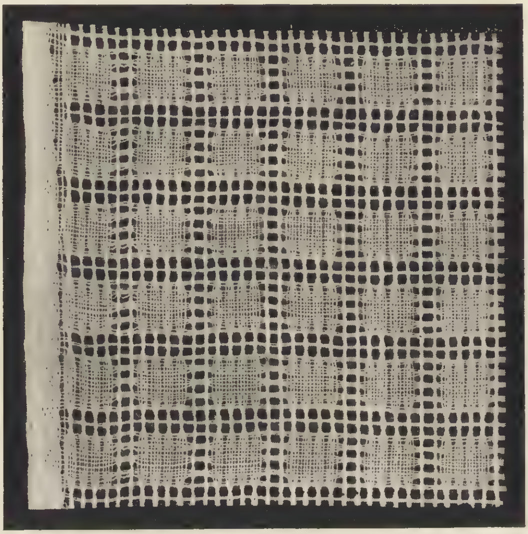


FIG. 432.—Check Gauze Fabric.

through the warp shed. If *bottom* doups are employed, cross sheds are formed by *raising* front standard and doup healds positively by the dobby, whereby better and clearer warp sheds are formed. In consequence, however, of the cloth being woven face downward by them, as previously described in § 100, they are not generally used for net leno and similar fabrics, but are chiefly confined to the production of those fabrics not containing thick net doup threads, and of which both sides are exactly similar, such as that illustrated in Fig. 432. Also, the renewal

of bottom-doup slips is much more difficult than the renewal of top doups ; but if bottom doups break, they fall away from warp ends, and do not, therefore, become entangled with them.

Relative Merits of Different Types of Dobbies for Gauze and Leno Fabrics.

§ 108. In the production of gauze or leno fabrics it is desirable to effect a crossing of warp ends with the least possible straining or chafing of those threads. This desideratum is the principal stumbling-block to the successful adoption of dobbies that are unprovided with auxiliary attachments which specially adapt them for leno weaving. To avoid excessive straining and chafing of warp ends, whilst in the act of crossing each other, one of two conditions must exist, namely, either the crossing threads must be quite level at the *commencement of crossing*, that is, when rising and falling warp ends meet in the centre of the warp shed ; or else doup threads must pass either from the *upper* or else the *lower* part of the warp shed, when the crossing takes place, according to whether a *top* or a *bottom*-doup harness, respectively, is employed. It will now be manifest, therefore, that either a "closed-shed" dobby, or one that will produce the conditions just described, is better adapted than an "open-shed" dobby for leno weaving. By reason, however, of open-shed double-acting dobbies enabling a loom to be worked at a greater speed than is possible with "closed-shed" dobbies (which are necessarily single-acting) it is a common practice to employ an open-shed dobby for leno weaving. In such cases it is expedient to equip either the dobby or else the loom with a suitable auxiliary attachment known as a "shaking" device, to enable the crossing of warp ends to take place as freely as possible.

Shaking Devices.

§ 109. The function of a shaking device is to facilitate the crossing of warp ends when forming *both* cross and open sheds ; but since it is, under certain conditions, unnecessary to employ a shaking motion for the reproduction of some leno designs, it

will be useful to indicate when shaking is, and when it is not, necessary. If either an open-shed dobby (like the "Keighley" type) or a semi-open shed dobby (like the "Burnley" type) is employed for leno weaving, with either a top or a bottom-doup harness, it will be expedient to employ a shaking motion for designs that require a *cross shed to immediately succeed an open shed, and vice versâ;* but such a motion is not required for designs in which one or more than one pick intervenes between cross and open sheds as exemplified in the net leno stripes A, Fig. 405; B, Fig. 407; and B, C, Fig. 409; because for those picks, doup threads would be *raised* by a top-doup harness, and *depressed* by a bottom-doup harness, and would therefore pass either from the upper or lower part of the warp shed, respectively, as described in § 108. The reason for this will be manifest after a little reflection upon the circumstances. With a *top-doup* harness, *cross sheds* are formed by *depressing doup threads* on the *crossed* side of their respective standard threads, which are raised; and *open sheds* by *depressing doup threads* on their *normal* side. Therefore, either standard threads should be lowered, or doup threads raised, at least half-way, to prevent excessive chafing of crossing threads during the formation of cross and open sheds. This operation is described as "shaking". With a bottom-doup harness the conditions of shaking are exactly contrary to those which obtain with a top-doup harness.

§ 110. "Shaking" is effected in a variety of ways, either by auxiliary attachments fixed either to the loom, or else to the dobby; and, as just indicated, it may be accomplished with a top-doup harness either by *raising* doup healds, or else by *depressing* the healds governing standard or regular warp ends half-way; and with a bottom-doup harness in a contrary manner, by depressing doup healds, or else raising standard threads half-way—the choice being frequently arbitrary. One very simple and common method of shaking *depressed* healds, without employing a special leno dobby, is to connect the required heald stave or staves to one of the arms (which connect the sley with the loom cranks) by means of a suitable arrangement of levers and connecting rods, as graphically represented by Fig. 433, in which A represents the loom cranks; B,

the connecting arms; and C, a connecting rod to oscillate an arm D mounted upon a square cross-bar E, placed above the healds, and upon which are also mounted half-moon quadrant arms F, to which the required healds are connected. The

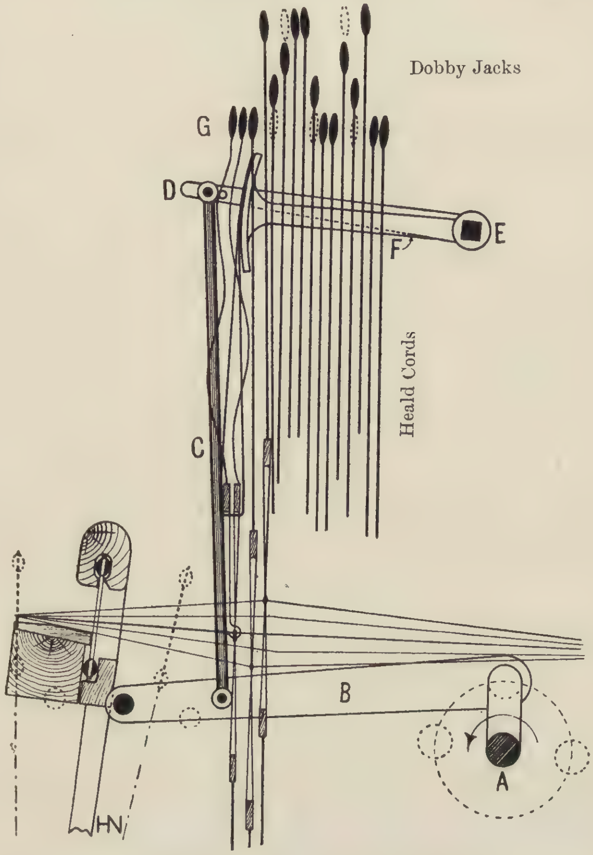


FIG. 433.—A type of "Shaking" Device to operate in conjunction with Open Shed Dobbies employed for Leno Weaving, to facilitate the crossing of Warp Ends.

same healds are also attached to separate dobby jacks G. The disadvantage of this arrangement, however, is that it does not permit of adjustment in relation to shedding, if such a course were necessary. Thus, the front standard and doup healds,

which are being shaked, are raised to the centre of the warp shed by the time the loom cranks arrive at the top centre of their circuit. This is one-eighth of a revolutiou sooner than the time usually selected for rising and falling healds to meet in the centre of the warp shed, when doup and standard warp ends commence to cross each other. This is indicated in the diagram by representing rising and falling dobby jacks G, a short distance from the centre of their complete movement. Still it has the advantage of being simple, and is found to give satisfaction under some conditions.

§ 111. Another method of shaking *depressed* healds from the loom is graphically represented by Fig. 434. By this method, in addition to being connected to separate dobby jacks G, the healds required to be shaked are also attached to half-moon quadrant arms F, that are secured to a cross-bar E, placed above the healds. This is caused to oscillate by connecting it, by means of an arm D, and connecting rod C, to a lever H, mounted upon a stud I, and fixed outside the loom framing. Lever H is furnished with a bowl or runner J, and is alternately depressed and raised by the combined actions of a double-acting tappet K (fixed upon the picking shaft L), and a spring M, respectively, which may be attached to any convenient part of the loom framing. With this shaking device, shaking may be timed to take place at exactly the right moment, by adjusting tappet K to operate the required healds so that their movement exactly synchronises with the movement of healds controlled by the dobby. This is indicated in the diagram by representing the dobby lifting-crank N in a horizontal position, when rising and falling healds meet midway (as indicated by the three positions of dobby jacks G). At the same time the front standard and doup healds have been raised to the centre of the shed, when the crossing of doup and standard warp ends commences. Also the loom cranks are half-way between the top and front centres, and therefore one-eighth of a pick (forty-five degrees) in advance of those represented in Fig. 433.

§ 112. When adapted to open-shed dobbies of the "Keighley" type, shaking devices may only shake *raised* healds by first lowering and then raising them. Some dobby makers furnish

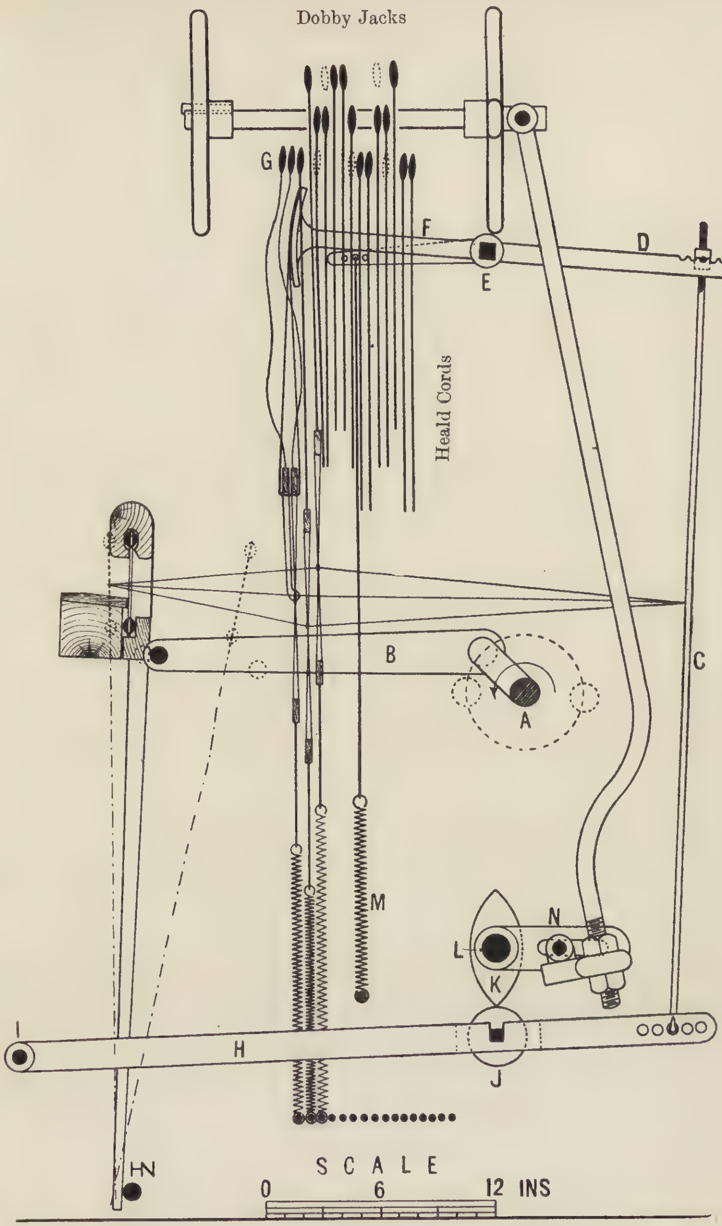


FIG. 434.—A second type of "Shaking" Device to operate in conjunction with Open Shed Dobbies employed for Leno Weaving, to facilitate the crossing of Warp Ends.

their dobbies with a shaking device of some kind, and style them "leno" dobbies; but one of the most efficient and inexpensive methods of shaking with an open-shed double-acting dobby is to connect *two* contiguous jacks of the dobby to each heald that requires shaking, and operate them from the pattern lags as required. By this means a heald may be lowered by one jack until it falls half-way, when it is caught and taken to the top again by the ascending fellow-jack. By governing the operation of shaking from the pattern lags, this arrangement is superior to all other shaking devices, as it enables shaking to be performed only when it is necessary, and at the exact moment when it is most effective; whereas other shaking devices operate for every pick, whether shaking is required or not; thereby vibrating healds and warp ends unnecessarily and detrimentally, as explained in the following section.

When adapted to a semi-open shed dobby, like the "Burnley" dobby, shaking must be effected with *depressed* healds. This type of dobby is better adapted than an open-shed dobby for leno weaving, because it allows *all* healds to fall half-way after each pick; therefore, by raising half-way those healds that require shaking, standard and doup threads actually meet in the centre of the shed, thereby achieving the same result (in respect of crossing threads only) as that obtained by means of a closed-shed dobby.

§ 113. Before dismissing the subject of shaking, it will be of practical interest to indicate the circumstances under which it is quite inadvisable to employ any kind of shaking device to shake the front standard and doup healds (of a top-doup harness) after every pick; and also when it is more expedient to employ either a closed-shed dobby or else a shaking motion that may be made to operate only when required. For example, if a net leno design requires doup threads to remain down for several picks in succession, when on the open or normal side of their respective standard warp ends, the doup slips and their warp ends would rise half-way in the warp shed and return to the bottom again for every pick of weft; albeit those threads would be held down by the back standard heald. This would involve excessive straining and breakage of doup threads and rapid

wearing out of doup slips. For these reasons, therefore, it would be better to employ either a closed-shed dobby, or else a shaking motion that could be controlled from the pattern lags in the manner described in § 112, whereby shaking may be effected by *depressing standard warp ends* only when it is absolutely necessary.

Practical Details of Leno Weaving.

§ 114. The position of back standard healds, which govern doup threads, in relation to those governing standard or regular warp ends, is arbitrary. Some advocate placing them to the *rear* of regular healds, as indicated in Figs. 402, 403 and 404; and others prefer to place them in *front* of regular healds, as represented in Fig. 406, and subsequent charts of drafts for leno designs. The advantage is probably in favour of the latter course; for, whilst it reduces the distance between the "fell" of cloth and the back standard heald eyes (and thereby imparts a little greater tension upon doup threads during the formation of "open" sheds) it averts the chafing of doup threads against the leashes of the regular healds, around which they would bend, when forming "cross" sheds.

§ 115. In consequence of the additional tension imparted to doup threads during the formation of cross sheds, and the consequent rapid wear of doup slips and healds, it is expedient, for reasons of economy, to make designs that will require as few "cross" sheds as possible, consistent with the effect it is desired to produce in cloth. Also, when one or more than one doup thread crosses two or more standard warp ends, it will be better to raise (with a top-doup harness) *all*, in preference to a part, of those threads, when forming cross sheds; and thereby equally distribute the strain of shedding upon them.

§ 116. In the production of some net leno fabrics in which the doup threads are abnormally thick, or which have to cross with a large number of standard warp ends, it is advisable in such cases to remove one or more than one reed wire, if necessary, to prevent excessive chafing of warp ends by being too confined and by bearing hard against the reed wires, as described in § 94. What is known as a "flexible" reed is well adapted

for net leno fabrics. Such a reed is formed by wrapping the reed ribs on one side with pitched banding, in the usual manner; and those on the other side with dry or unpitched banding. By this means considerable flexibility is obtained in the reed, which permits of the easy passage of knots or other obstructions, with less risk of breaking warp ends. The dry banding allows a limited amount of vertical movement by the reed wires, which enables them to readily recover their original position after being bent out of a straight line. Also a deeper reed than those usually employed should be used for leno fabrics, to allow warp ends more freedom, and also to enable it to be more easily displaced, in the event of a shuttle failing to pass safely through the shed.

Tempered Steel-wire Doup Harnesses for Cross-weaving.

§ 117. The loops or slips, termed "doups," employed in conjunction with either heald or Jacquard harnesses for the purpose of effecting the crossing or douping of warp ends that characterises gauze and leno fabrics produced by cross-weaving, are usually made from worsted twine, which is more durable than cotton twine, and more supple and elastic than linen twine. Albeit, the rapidity with which worsted doup slips wear out and break during weaving constitutes one of the chief difficulties experienced in the manufacture of fabrics constructed by their aid. The rapid wear of doup slips arises from the excessive abrasive friction to which they are subjected, during weaving, within their respective front "standard" heald or mail eyes. Their breakage not only incurs the risk of causing imperfections in cloth by becoming entangled with and breaking warp ends, but the difficulty usually experienced of repairing defective doups, or replacing them with new ones, imposes a severe tax upon the duties of a weaver; and by involving loss of time, curtails production.

With the object of averting the disadvantages of worsted doup slips, and securing greater efficiency and durability than they afford, H. Kühn & Co., Chemnitz, have substituted tempered steel wire, in lieu of twine, in the construction of doup harnesses

of various forms adapted to the special requirements of fabrics of different texture, and applicable to either heald or Jacquard harnesses for gauze or leno weaving. After being bent and shaped into the desired forms, the wires composing the respective units of a harness are neatly soldered where it is necessary to either fill up small interstices, or to effect a union between two hitherto separate portions, to increase their stability. The wires are subsequently tinned to prevent them from rusting, and also to give them a highly smooth finish, to reduce frictional resistance between them and warp ends to a minimum.

The simplest form of steel-wire doups referred to, as represented by Fig. 435, differs very little in construction from doup harnesses made from twine. In this example, the upper half only of the front standard S is open, to contain one side of the doup slip D, in which is formed an eye to receive a doup warp end (as shown) by coiling the wire at the bend. A modified form of steel-wire doups suitable for finer warp yarn is represented by Fig. 436. In this example the doup slip D is a simple loop of the usual form, without an eye being formed at the bend. In the present case, however, the doup slip is inserted in both the upper half of the front standard S which is open, and also in loops formed at the bend of the lower half of the front standard, as indicated in the diagram. A third modification of wire doups is represented by Fig. 437, showing, at A, the constituent parts in their initial position which they occupy when the warp shed is closed; and, at B and C, the positions they occupy during the formation of open and cross sheds respectively. The special feature of this device consists of a doup slip D acting in conjunction with two separate front standards S^1 and S^2, each of which is formed with a long central loop or eye to contain the respective sides of the doup slip, as shown in the diagrams. The doup slip used in this modification, like that shown in Fig. 435, has an eye formed at the bend for the reception of a doup warp end, and is situated *between* the two front standards. With this device an open shed is formed by raising the doup slip along with *either* of the two front standards; whilst a cross shed is formed by raising the doup and the *other* front standard, whereby doup warp ends will be raised first on one side and then on the

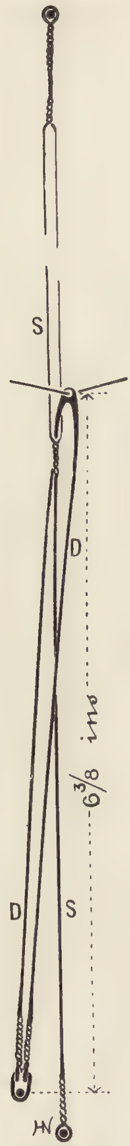


Fig. 435.

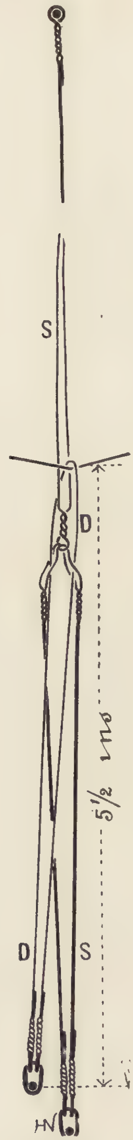


Fig. 436.

Units of two Types of Steel Wire Doup Harnesses for Cross-weaving.

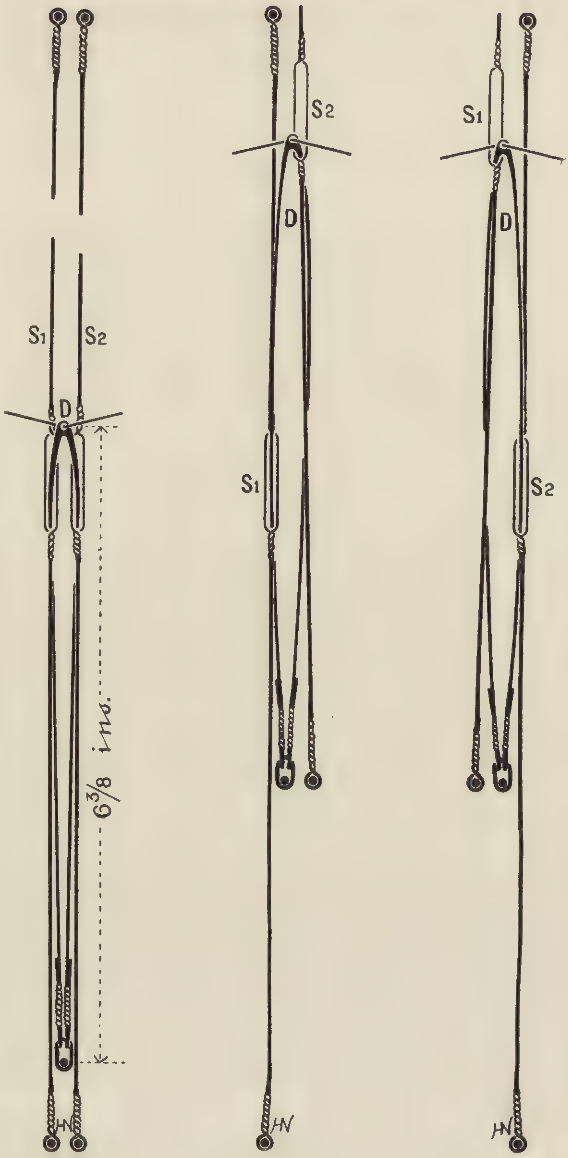


FIG. 437 A.

FIG. 437 B.
FORMATION OF
OPEN SHED.

FIG. 437 C.
FORMATION OF
CROSS SHED.

Units of a third Type of Steel Wire Doup Harness for Cross-weaving.

opposite side of their respective standard or regular warp ends, as indicated by Figs. 437 B and C. This arrangement therefore dispenses with the usual back standard heald.

As previously stated, the steel-wire doup harnesses under present notice are applicable to both heald and Jacquard harnesses. If they are to constitute a heald harness, their looped extremities are slid upon wires stretched along and secured to heald staves; but if they are to constitute a Jacquard harness, the wire units composing the harness are attached to mounting threads and lingoes, after the manner of ordinary twine couplings. It should be observed, however, that whatever form the harness may assume, the use of tempered steel-wire doups imposes certain restrictions and limitations in either the choice of shedding apparatus by which they are to be actuated, or else in the character of the designs that may be produced by their use, for reasons to be presently stated. The tempered steel wire, of which the units of the harnesses are made, is comparatively rigid, and lacks the suppleness and pliability of twine, which is capable of readily yielding and bending, and of freely adapting itself to the conditions imposed by shedding with a doup or leno harness. For this reason, steel-wire doups may only be employed in conjunction with single-acting Jacquard machines, single-acting dobbies, or other shedding appliances that bring all standard and doup warp ends parallel after each pick is inserted, to facilitate their crossing from their normal or open position to a crossed position or *vice versâ*: otherwise, if they are employed in conjunction with open-shed machines, designs produced by them will have to be restricted to such as may be developed without the necessity of bringing doup and standard warp ends parallel after each pick, unless that object is achieved by means of a "shaking" device. For the same reason, they may not be employed in the form of a half heald to operate in conjunction with either a leno brocade (Jacquard) harness, or a leno heald harness in which several back standard healds operate in conjunction with one doup and one front standard heald (as described in §§ 95 to 103). In either of these two circumstances, it frequently occurs that some doup slips are taut, whilst others are buckled, according to the different relative positions occupied

by standard and doup warp ends in different parts of the harness. Hence, if wire doup harnesses (which are not so pliable as twine) are employed in such cases, each unit of the harness will require to be under separate control.

Mock or Imitation Leno Fabrics.

§ 118. The term, "mock" leno, describes a variety of weaves of ordinary construction, in which the scheme of interweaving warp and weft is designed to produce open-work effects which simulate, in a very realistic manner, the genuine gauze and leno

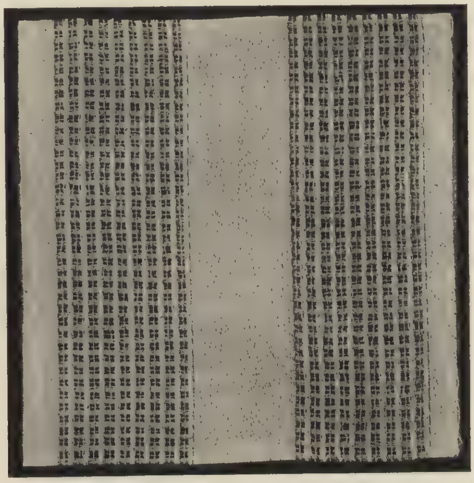


FIG. 438.—Fabric with Mock Leno Stripes.

effects produced by the principle of cross weaving, as described in the previous sections of this chapter. Mock leno or open-work effects are sometimes produced alone, but more frequently in combination with the plain, a twill, satin or other simple weave, and sometimes with brocade figuring, to produce striped fabrics which oftentimes bear a very close resemblance to true leno fabrics. They are also frequently used as ground fillings in brocade fabrics containing elaborately figured Jacquard designs, in imitation of leno brocade fabrics produced by a special gauze or leno harness.

Fig. 438 is a photographic reproduction of an example of cloth woven with mock leno and warp satin stripes arranged alternately, and will serve to illustrate the realistic leno effects that may be obtained without employing a leno harness. Mock leno weaves are of very simple construction, and are chiefly dependent upon the frequent counterchanging of a suitable weave, to produce the desired effects. A few examples of these weaves are given in Figs. 439 to 442. Fig. 439 is a simple pattern counterchanging on three warp ends and picks, and therefore repeats on six threads of warp and weft. The counterchange after the third and sixth warp ends and picks, combined with the particular method of interweaving them, produces distinct gaps or "frets" both lengthwise and crosswise of the fabric, and thereby creates a decided gauze or leno effect in cloth. The warp ends may be passed in pairs through each dent of the reed; but the leno effect will be emphasised by passing them in groups of three through each dent, commencing with the first three warp ends in the design.

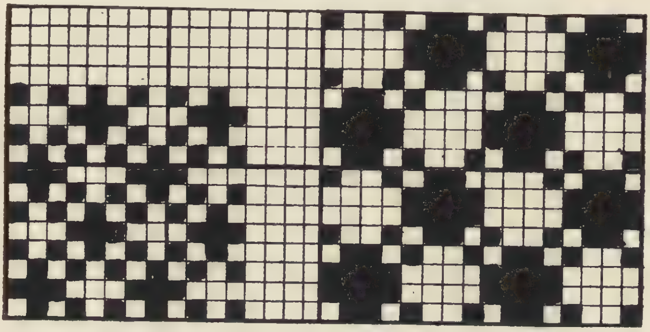


Fig. 439. Fig. 440.

Mock Leno Designs.

Another good mock leno effect is produced by the "canvas" weave represented in Fig. 440, so extensively employed in the manufacture of the well-known canvas cloth, usually produced in coarse textures from strong folded warp and weft, and chiefly used for the purpose of cross-stitching and other fancy needlework. This design is really a further development of that given

in Fig. 439, and is made to counterchange after every four threads in both warp and weft, so that the pattern repeats on eight threads each way. The small perforations characteristic of this fabric, and through which the needle is inserted (when employed for fancy needlework), result entirely from the counterchange of the threads. The occurrence of the perforations is quite incidental to that weave, and therefore unavoidable. If it is required to introduce the canvas weave as a mock leno effect, in conjunction with another weave, to form stripes, a superior effect will result by passing warp ends in groups of four through each dent of the reed.

A third example of a mock leno effect, which is very extensively employed, is that illustrated by Fig. 438. The design for

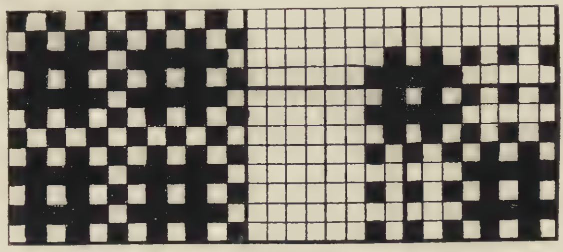


FIG. 441. FIG. 442.

Mock Leno Designs.

that example (as given in Fig. 441) repeats on six warp ends and six picks, and is counterchanged after the fifth and sixth threads in both directions, thereby causing the sixth thread of warp and weft to become quite isolated from adjacent threads, and so develop a leno effect of a very pronounced character. By drawing the first five warp ends in the first dent, and the sixth warp end in the third dent, with the second and fourth dents left empty, a very realistic simulation of a genuine gauze or leno effect is developed in cloth. A modification of this weave is given in Fig. 442. With this weave warp and weft would be displayed in equal quantities on both sides of cloth. This circumstance is favourable to the effective introduction of coloured threads (say, the second, fourth, seventh and ninth warp ends and picks) to produce pleasing decorative effects. The mock leno designs

given in Figs. 441 and 442 bear a close resemblance to the sponge design given in Fig. 237 (§ 43) and also to the huck-a-back weave, Fig. 245 (§ 44) to which they are closely allied ; and if warp ends were suitably drawn through the reed, those weaves would also develop good mock leno effects. Many other varieties of mock leno designs could be given, but the present examples are sufficient to demonstrate their general character.

CHAPTER X.

TISSUE, LAPPET AND SWIVEL FIGURING; ALSO ONDULÉ EFFECTS AND LOOPED FABRICS.

§ 119. The terms "tissue," "lappet," "swivel," "ondulé" and "looped" fabrics are used to designate certain varieties of woven fabrics, each of which is distinguished by certain characteristics. Such fabrics do not, as a rule, embody any special feature of constructive design, but merely consist of light and simple textures which, during weaving, are embellished with a scheme of figuring developed by one or other of the systems just named. Such fabrics, therefore, owe their chief interest to the special mechanical devices employed in their production; but as that phase of fabric structure is only incidental to the main purpose of this treatise, it is proposed to chiefly describe the salient features of those fabrics, with only such description of the mechanical devices employed in their production as will enable students to more readily and intelligently comprehend how the figuring is developed upon them. The chief advantages of figuring textiles by means of tissue, lappet and swivel weaving are to produce decorative effects without materially increasing either the bulk or weight of a fabric, and to produce such effects with a minimum amount of material.

Tissue Figuring.

Tissue figuring is a system chiefly employed in the production of light cotton muslin textures intended for use as window curtains, of which an example is illustrated in Fig. 443. Fabrics of this class are frequently embellished with elaborate Jacquard designs of great beauty. These are developed by means of an extra series of picks which interweaves with a foundation tex-

ture of either the plain calico weave, or, as in "Madras muslin," upon a texture of gauze produced on the principle of cross-weaving, whereby the extra figuring weft is firmly secured to the principal texture. The figuring weft is both softer and coarser than that employed for the body of the fabric, with the object of imparting prominence to the figure. These two series of picks may be inserted in the order of two ground and

FIG. 443.—Light Muslin Fabric with Pattern developed by means of Tissue Figuring.

two figuring picks, alternately; or one of each alternately; or one ground pick, and two figuring picks alternately. The two-and-two system of picking is, however, more economical, as it may be accomplished in a loom equipped with an ordinary picking motion, and with two shuttle boxes at only one end of the sley. If either of the other two systems of picking were adopted, they would involve the use of a loom provided with a special picking motion, to permit of picking two shuttles in

succession from each end of the sley, which latter would require two shuttle boxes at each end.

The example of tissue weaving, illustrated in Fig. 443, has a foundation texture of muslin of the plain or tabby weave, woven with two ground and two figuring picks alternately. In fabrics of this class, the extra figuring weft interweaves only with warp ends where it is required to produce figure, and (when in the loom) floats loosely *above* all warp ends in the ground portion of the fabric, from which it is subsequently cut away as superfluous material. By weaving these fabrics face downward the work

Fig. 444.—Portion of the Design for Tissue-figured Fabric represented by Fig. 443.

of shedding is made considerably easier, as all warp ends in the ground portion are left down *en masse*. A portion of the design showing the method of interweaving figuring weft with the foundation texture is given in Fig. 444, in which it will be seen that the first two and subsequent alternate pairs of picks (which are fine ground picks) interweave separately with warp ends on the tabby (plain calico) principle throughout, and thereby develop a perfect texture, irrespective of figuring weft; whereas, the third and fourth, and subsequent alternate pairs of picks (which are coarse figuring picks), interweave with warp

ends, only where they are required to be retained in the fabric for figuring purposes, and float above intervening warp ends. In the figure portion, figuring picks lie together in pairs (although inserted separately during weaving) between odd-numbered and even-numbered warp ends by which they are firmly secured to the principal texture.

On examining the design it will be observed that figuring picks always lie between the *same series* of warp ends; that is, say, with odd-numbered threads above, and even-numbered threads below them. This circumstance permits of a more economical production of these fabrics, as *alternate* warp ends only require to be governed by means of a Jacquard machine, and intermediate warp ends by means of a heald. Thus a Jacquard machine with 408 hooks would serve to produce a design extending over any number of warp ends up to 816. Also, since two figuring picks are inserted between the same series of warp ends, only one pattern card would be required for four picks of weft, provided the card cylinder and griffes were controlled independently. For example, when the first ground pick is inserted, the heald only is raised; when the second ground pick is inserted, the griffes of the Jacquard machine are raised with the card cylinder *out*: and for the third and fourth picks, which are figuring picks, the griffes ascend and take up only such hooks as govern *alternate* warp ends in the figure portion of the fabric, in accordance with the selection made by the pattern card for those picks.

Not only does the foregoing system effect a considerable saving in the cost of harness threads, pattern cards and card cutting, but it also greatly facilitates the preparation of designs, as the latter may be prepared *en bloc*, instead of with the actual working of each thread of warp and weft being indicated as in Fig. 444. Therefore, since only alternate warp ends are governed by the Jacquard machine, and only one pattern card is necessary for four picks, the counts of design paper required for a design is in the ratio of *warp ends per inch*, divided by two, to the *total picks per inch*, divided by four. Thus, assuming there are to be forty-eight warp ends and eighty-four picks per inch, in the finished fabric, the required counts of design paper (for a 400's

Jacquard machine with eight rows of hooks from front to back) would be in the ratio of $(48 \div 2) = 24$, to $(84 \div 4) = 21$, or ruled with eight squares by seven squares in each bar.

Madras Muslin.

§ 120. Fig. 445 is a diagram showing the structure of that variety of tissue-figured fabrics known as "Madras muslin," of

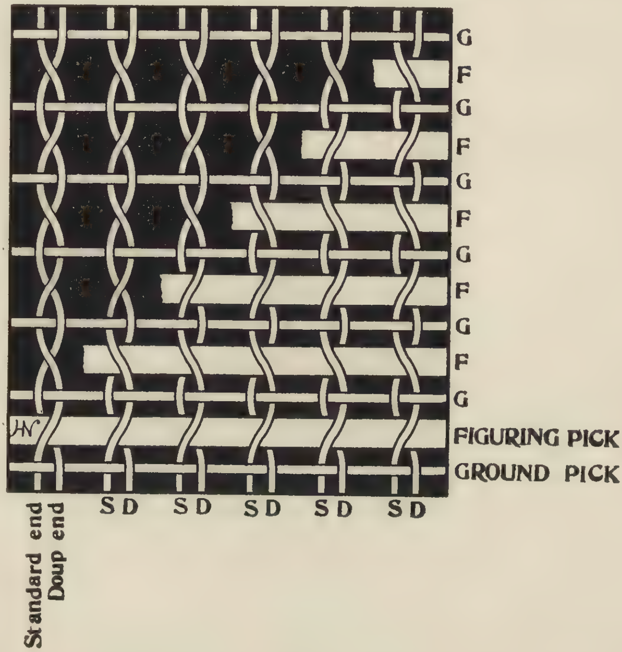


Fig. 445.—Graphic Diagram showing the structure of "Madras" Muslin Fabrics.

which the foundation texture is of gauze or cross-weaving. The diagram represents a fabric in which ground and figuring picks are inserted *alternately*, thereby requiring for its production a loom having a "pick-and-pick" picking motion, and with two shuttle boxes at each end of the sley.

The peculiar partial crossing of warp ends in these fabrics is obtained by the use of a special kind of reed known as a gauze

reed, which is auxiliary to the ordinary beating-up reed carried by the sley. A gauze reed, as illustrated in Fig. 446, is constructed with wide dents or divisions A, in each of which is centrally fixed a short pointed reed wire B, secured to the bottom rib C, and extending about half-way between the bottom and top ribs. The shorter reed wires are each provided with an eye D, near the top, for the reception of alternate warp ends,

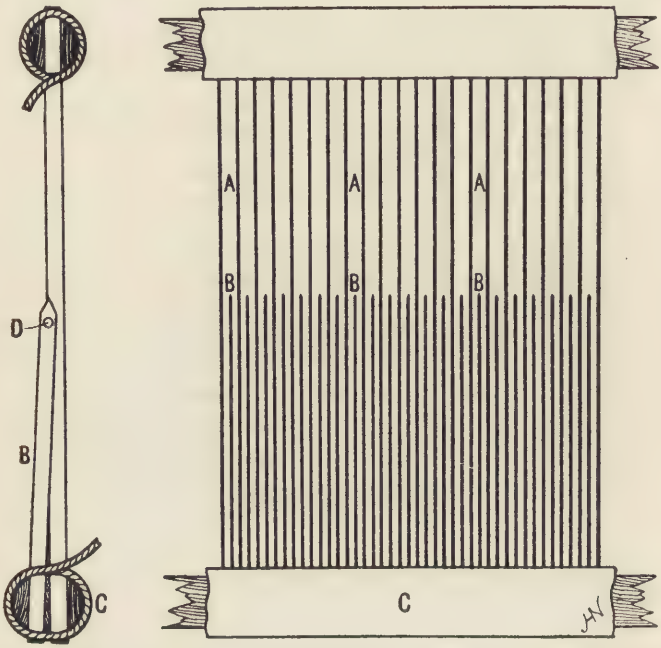


FIG. 446.—Gauze Reed, as employed in weaving "Madras" Muslin Fabrics.

termed "doup" threads. The intermediate warp ends, termed "standard" threads, which are controlled by the Jacquard harness, pass separately through the wide dents of the reed. A "doup" and a "standard" thread, contained in the same dent of the gauze reed, are also passed together through the *same dent* of the ordinary reed to permit of their crossing each other. When in the loom, a gauze reed is placed a little in front of the Jacquard figuring harness, as shown at E (Fig. 447), and is

raised to form a warp shed for the insertion of ground picks only. Its function, therefore, is analogous to that of a "doup" heald in an ordinary gauze loom. Previous to the ascent of the gauze reed, the Jacquard harness is moved sideways for a short distance, first to the right (when facing the loom) and then to the left, for consecutive ground picks, thereby placing "standard" warp ends on opposite sides of "doup" warp ends for the

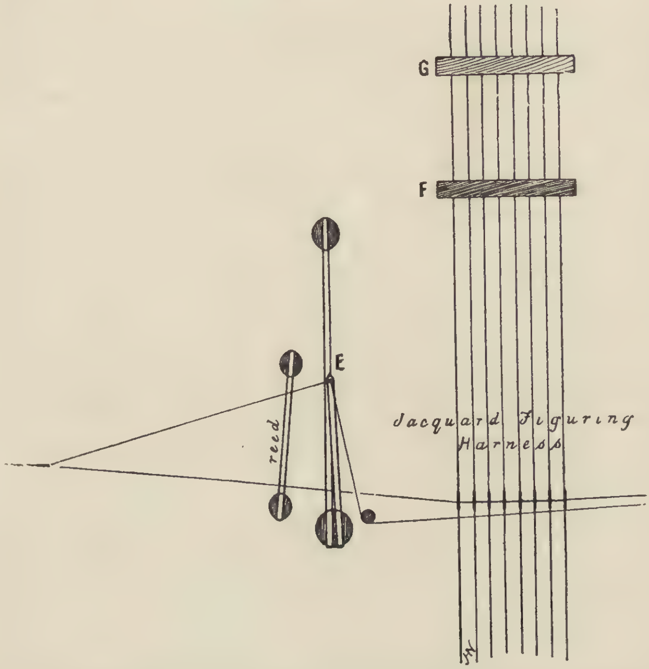


FIG. 447.—Part Sectional End Elevation of a Loom for weaving "Madras" Muslin Fabrics.

purpose of crossing and recrossing them. The lateral side movement of harness threads, and the consequent movement of "standard" warp ends which they control, is accomplished by means of an auxiliary comber board F, situated a few inches below the ordinary comber board G. The auxiliary comber board is virtually a coarse wire comb whose teeth are crossed at right angles by three or four wires, so as to form compartments

for the reception of several mounting threads to prevent the latter from swinging. Comber board F receives its lateral movement in one direction by means of a lever connected to it at one end, and actuated by a cam; whilst its return movement is effected by means of a spring attached to the opposite end of the comber board, and which is constantly pulling against the lever.

On referring to Fig. 445, it will be seen that all "doup" warp ends only are raised for the insertion of ground picks, and that "standard" warp ends are raised *en màsse* in the figure portion only, and left down *en masse* in the ground portion, for the insertion of figuring picks. Thus, figuring weft lies *between* "doup" and "standard" warp ends in the figure portion, and floats loosely above *all* warp ends in the ground portion of the fabric, from whence it is subsequently cut away as waste material.

Madras Muslin with Two and More Colours of Figuring Weft.

§ 121. Madras muslin fabrics are sometimes woven with two different colours of figuring weft to increase their decorative effect. In the production of this variety, three shuttles are required, namely, one to insert the fine ground picks, and one each to insert the respective figuring picks of coloured weft. The three shuttles are picked across the loom in succession; and although it may not at first appear to be practicable, it will, upon reflection, become manifest that a loom furnished with an ordinary picking motion, and two shuttle boxes at each end of the sley, will enable that order of picking to be achieved without having recourse to a more complex and costly type of loom with a "pick-and-pick" motion, and three shuttle boxes at each end of the sley.

A pick of each colour of figuring weft is inserted after every ground pick; and they may be displayed in any manner according to the desired scheme of decoration. For example, each colour of weft may be displayed alone, or picks of each colour may be inserted alternately with each other in the same part of the fabric, in order to produce a chintz or mingled effect by blending the two colours together. In the figure portions that are developed in such a manner, alternate standard

warp ends only are raised in those parts for picks of one colour, and intermediate standard warp ends only for picks of the other colour. In all other respects, this variety of Madras muslin is similar to the two-shuttle variety described in § 120. Some Madras muslins contain as many as three and four different colours of figuring weft, which may be displayed either independently, or in any combination with each other, as desired.

Lappet Figuring.

§ 122. Lappet figuring is usually confined to the ornamentation of light muslin textures of cotton, and sometimes of silk, of the plain or calico weave; and less frequently it is employed in combination with gauze or leno and other woven effects. It consists of the development of figured effects produced by a more or less zigzag arrangement of extra warp threads, withdrawn from one or more than one auxiliary small warp beam. These extra warp ends are wrought into the foundation texture *without interweaving with warp ends*, and are permanently held in position by passing *underneath picks of weft* (when cloth is viewed obversely). The figuring warp threads, termed "whip" threads, are thereby made to lie in the same direction as picks of weft, which float quite freely on the face side of cloth only, between the points of their intersection, as clearly indicated in the accompanying photographic reproductions of lappet-figured fabrics. These characteristics are specially emphasised because they constitute the essential principles of lappet figuring, which sometimes bears a close resemblance to swivel figuring; and when once properly understood, they enable the difference between lappet and swivel figuring to be readily discriminated.

Lappet figuring is confined to the production of comparatively simple decoration, as the system prohibits the development of such elaborate designs as are frequently met with in tissue-figured and swivel-figured fabrics, which varieties are usually produced by means of a Jacquard machine. The examples of cloth represented in Figs. 449 to 456 will serve, better than any verbal description, to indicate the general character and scope of lappet figuring; whilst the following brief description of the

essential features of a lappet loom will enable the production of these fabrics to be more easily comprehended.

§ 123. Lappet looms differ in details of construction, with different loom makers; but there are certain essential auxiliary parts common to all. These are represented in part sectional elevation by Fig. 448, and comprise one or more needle-frames B, B^1, situated between a reed A of ordinary construction, and

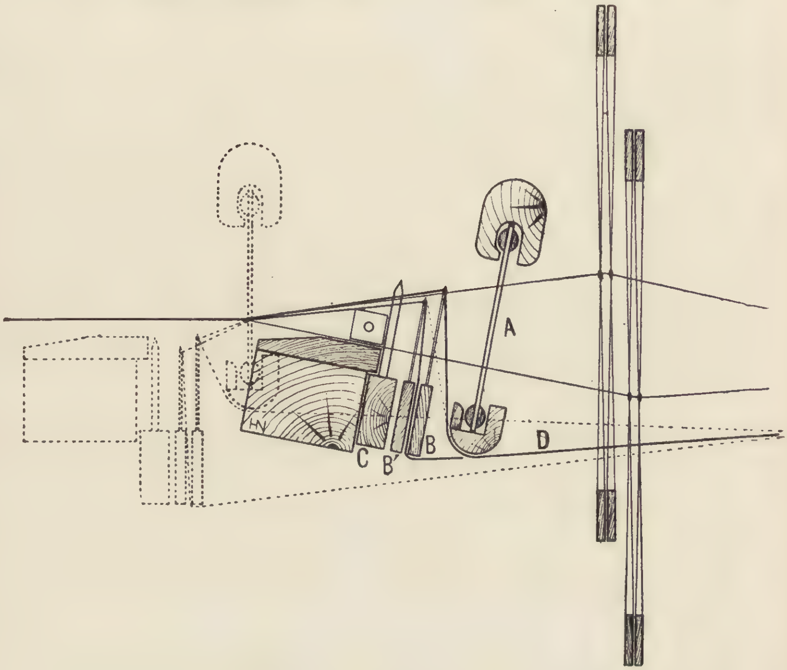


FIG. 448.—Part Sectional End Elevation of a Loom adapted for Lappet Figuring.

a false reed or pin-stave C, all of which parts are supported by, and oscillate with, the loom sley, as indicated by representing those parts at their rear and forward extremities of their movement, by means of full and dotted lines respectively. The reed A, which is situated several inches to the rear of the position a reed usually occupies, serves the usual functions of maintaining an even distribution of warp ends over the required width of

cloth, and of beating up picks of weft. The pin-stave C is a stave containing a number of sharply-pointed pins, placed vertically at intervals of about an inch to an inch and a [quarter. This is placed immediately behind the rear edge of the shuttle race-board, and alternately rises and falls in unison with the backward and forward strokes of the sley. Its function is to serve as a guide for the shuttle in its passage through the warp

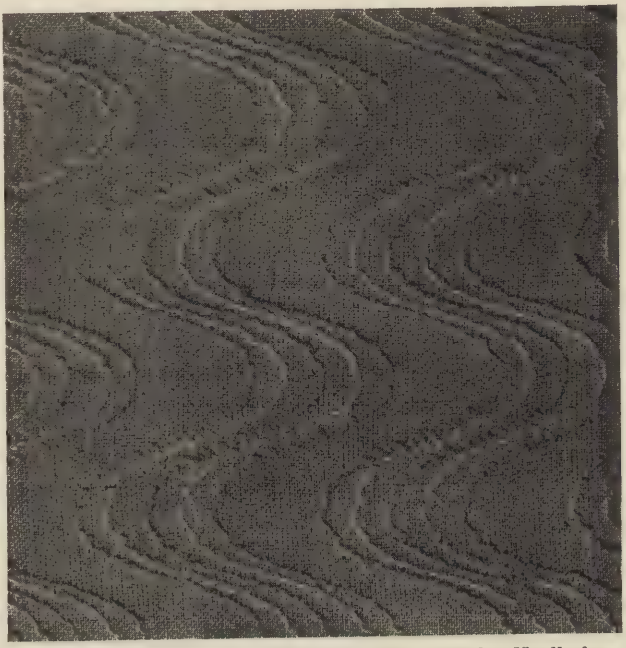


FIG. 449.—Fabric with Lappet Figuring produced by One Needle-frame.

sheds, after which it disappears below warp ends and cloth, as the sley advances to beat up the picks of weft.

The needle-frames B, B[1] are narrow staves, each containing a series of sharply-pointed needles placed vertically, and having eyes formed near the top, for the reception of whip or figuring threads, which they control. In addition to their oscillation with the sley, needle-frames receive a reciprocal compound movement both vertically and laterally. These movements

synchronise with the backward and forward strokes of the sley respectively. Thus, as the sley recedes, and just before picking takes place, needles are raised to insert their whip threads between the ordinary warp ends, to take their place with the upper half of the warp shed. Then, after each pick of weft is inserted in the shed, the needles descend, as the sley advances to beat up the picks of weft, which, by passing *underneath whip threads*, prevent the withdrawal of these as needles descend, and retain them at the points at which they were inserted between ordinary warp ends. When the needles have descended

Fig. 450.—Fabric with Lappet Figuring produced by Two Needle-frames.

a sufficient distance to be quite clear of warp ends and cloth, they may be moved laterally, in either direction, for the purpose of passing figuring threads from side to side of the figure, and placing them in the required positions, according to the pattern, ready for insertion into the warp shed for the next pick of weft.

The lateral movement of needle-frames may be effected in various ways, either by means of lattices furnished with pegs of different lengths, varying according to the amount of movement required ; or by means of shaped pattern or "lappet" wheels, of which there are several varieties. Perhaps the device known as the "Scotch" lappet motion is that most generally applied to

lappet looms. This motion essentially consists of a wooden pattern wheel or disc, freely mounted on a stud at one end of the loom, and having such number of irregularly stepped concentric grooves of uniform depth cut into the face side as corresponds with the number of needle-frames to be actuated by it. The configuration of each groove is in accordance with the particular movement to be imparted to the respective needle-frames, for the development of the required pattern. Each groove receives and acts

FIG. 451.—Fabric with Lappet Figuring produced by Two Needle-frames.

upon a small bowl or runner mounted upon a short pin or stud fixed in an extension of each needle-frame. These extensions pass horizontally in front of the wheel, so as to place the axes of the runners and pattern wheel in exactly the same horizontal plane. The rim of the pattern wheel is also formed with such number of saw or ratchet teeth as corresponds with the number of picks (or half that number, according to special circumstances) to be inserted in each repeat of the pattern. It will now be-

come manifest that by intermittently rotating the pattern wheel one tooth for each pick (or for every two picks) the needle-frames will be moved sideways in accordance with the configuration of the respective grooves, and thereby cause the whip threads to assume a more or less zigzag course, and float freely between the *extreme edges of figure without intermediate intersections.* A separate needle-frame is required for each distinct order of interweaving the figuring threads. If all figuring threads are required to interweave in the same manner, only one needle-frame, operated by one groove in the lappet wheel, is required; but, if figuring threads are required to interweave in four different orders, then four needle-frames operated by a figuring wheel

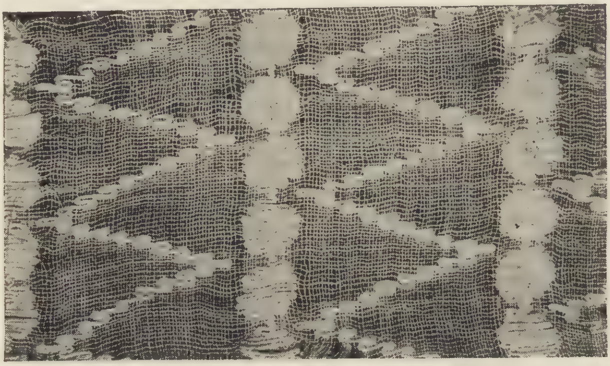


FIG. 452.—Fabric with Lappet Figuring produced by Two Needle-frames.

with four grooves will be required. It is rarely, however, that more than three needle-frames are employed in one loom.

Since needle-frames are situated below warp ends, it follows that the cloth will be woven face downward, and that the pattern is thereby obscured from the observation of a weaver. This circumstance is obviously to the disadvantage of a weaver, who is unable to readily detect any imperfection in the pattern that may arise during weaving: hence, in some lappet looms needle-frames are situated *above* warp ends, with the needles inverted, so as to weave the cloth face upward, and with the pattern in full view of a weaver. With this arrangement, however, the small warp beams containing the figuring threads are conveni-

ently placed above the healds; and as those threads descend in front to their respective needle eyes, they form an obstruction to a weaver when piecing and drawing in warp ends. Also, in consequence of inserting "whip" threads from above, instead of from below, regular warp ends, during shedding, they are more liable to cause the lower half of the warp shed to become uneven, and thereby impede the free passage of a shuttle during picking.

§ 124. Fig. 449 illustrates an example of lappet figuring pro-

FIG. 453.—Fabric with Lappet Figuring produced by Two Needle-frames.

duced by one needle-frame. In that example, groups of five figuring threads, of two different colours, are made to assume linear rounded waves or sinuous lines running lengthwise of the fabric. Fig. 450 is a more typical example of lappet figuring in which successive figuring threads are worked in opposite directions so as to produce a diamond formation, thereby requiring two needle-frames operated by two grooves in the pattern wheel. Fig. 451 is of a similar character to Fig. 450, but with two figuring

threads interweaving in opposite directions, to produce a double

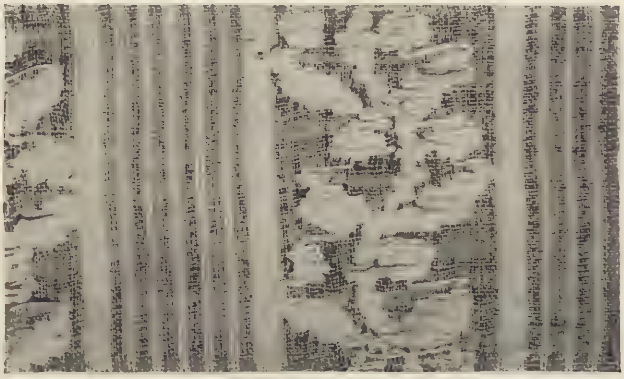


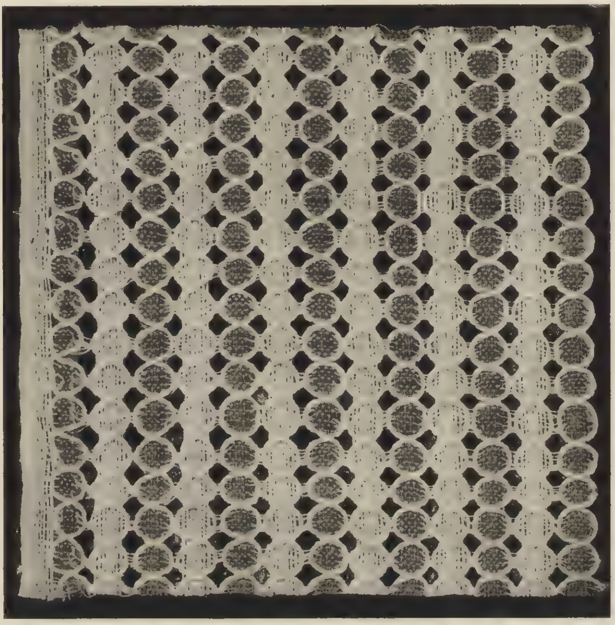
FIG. 454.—Fabric with Lappet Figuring produced by Three Needle-frames.

diamond effect, which would require two needle-frames. Fig.

FIG. 455.—Fabric with Lappet Figuring produced by Four Needle-frames.

452 is a stripe formation, produced by a pointed wave running

lengthwise, alternating with a stripe of beads, and would require two needle-frames. Fig. 453 is a peculiar all-over design which at first appears somewhat complex; but a close inspection will show that only two needle-frames have been required for its production. In addition to the lappet figuring, this specimen has been additionally embellished by means of a printed pattern. Fig. 454 is an unsuccessful attempt to represent foliage consist-



Selvedge

Fig. 456.—Fabric with Lappet Figuring of a Novel Character in which pairs of Whip Threads cross and re-cross each other at regular intervals, to develop a series of small circles, for which Two Needle-frames would be required.

ing of a running stem containing leaves and fruit. The pattern would require three needle-frames for its formation—one for the stem and two for the leaves and fruit on each side of it. Patterns of this description are not suited to lappet figuring, and are rarely achieved with success. Fig. 455 is a linear geometrical effect consisting of a combination of circles and diamonds, and would require four needle-frames for its production.

Cross-thread Lappet Figuring.

§ 125. A specimen of lappet figuring of a novel and ingenious character is illustrated by Fig. 456. In this example, figuring threads are caused to actually cross each other in reverse directions, and thereby develop an effect closely resembling that of a net leno produced by the principle of gauze or cross-weaving, for which it might easily be mistaken. For the production of such effects, it is only necessary to pass the figuring threads of one or more than one needle-frame, entirely underneath the needle-frame or frames that are in the rear of those, and thus permit of figuring threads passing or crossing each other. For example, if two needle-frames are employed, the figuring threads of the first frame must pass entirely underneath the second frame before passing through their respective needle eyes, as represented in the diagram, Fig. 448. The usual method of passing whip threads through the needle eyes is to take them upward immediately after passing underneath the lower reed case, and then insert them through their respective needle eyes, as indicated in the diagram by means of a dotted line extending from the lower reed case to a needle in the front frame B^1.

Spot Lappet Figuring.

§ 126. Some lappet fabrics are woven with detached figures arranged alternately, or otherwise, to evenly distribute them over the surface of cloth. In the production of such examples it is the usual practice, after weaving each horizontal row of figures, to cause the needle-frame or frames to automatically become inoperative until they are required for the next row of figures, when they are "shunted" sideways for the required distance, so as to dispose the figures of alternate rows either midway between those of intermediate rows, or otherwise, in a similar manner to the swivel-figured spots illustrated by Figs. 457A and 457B. Now, seeing that lappet fabrics are usually woven face downward (as explained at the end of § 123), it follows that whip threads will trail loosely between the intervals separating the figures produced by the same whip thread. These loose

threads are subsequently cut away, thereby leaving a short remnant or tail of thread *exposed on the face side of cloth*, at both the initial and final extremities of each figure, and causing blemishes of an objectionable character. This disfigurement, however, may be averted by causing the needles to rise in exactly the same position for all picks inserted between the end of one row of figures and the beginning of those in the next row, thereby inserting the respective whip threads uniformly between the same warp ends, for those picks. The object of this procedure is to cause the whip threads to trail or lie *above* the picks of weft between the horizontal rows of figures (when in the loom) and therefore to be on the reverse side or *back* of cloth, whence they are subsequently cut away, leaving the severed tail ends exposed on that side, and thus keeping the face of cloth free from such blemishes. Lappet figures or spots developed in accordance with this practice, and which are known in the trade as "tailless" lappet spots, constitute a superior style of lappet figuring as compared with those constructed in the usual manner.

Swivel Figuring.

§ 127. Swivel figuring is a system of ornamentation by means of extra weft inserted by auxiliary shuttles specially designed for the purpose. It is a method of figuring extensively adopted for the decoration of silk fabrics for book-marks, ties, ribbons, ladies' dress materials, and sometimes of light cotton fabrics for similar uses. Being of a more refined and elegant character than either "tissue" or "lappet" figuring, it is capable of producing decorative designs, figures, and pictorial representations of a floral and scenic description, in a very effective manner. The extra figuring weft is usually of silk, and, unlike "lappet" figuring, it may interweave with warp ends in any conceivable manner, instead of having to float loosely between the extreme edges of the figures. The foundation texture upon which swivel figures are formed is usually of the plain or tabby weave; or else that of a simple three-end or four-end twill weave. An example of swivel figuring of a very simple character is illustrated in Figs. 457A and 457B, which show both the face and back of the same fabric.

A

B

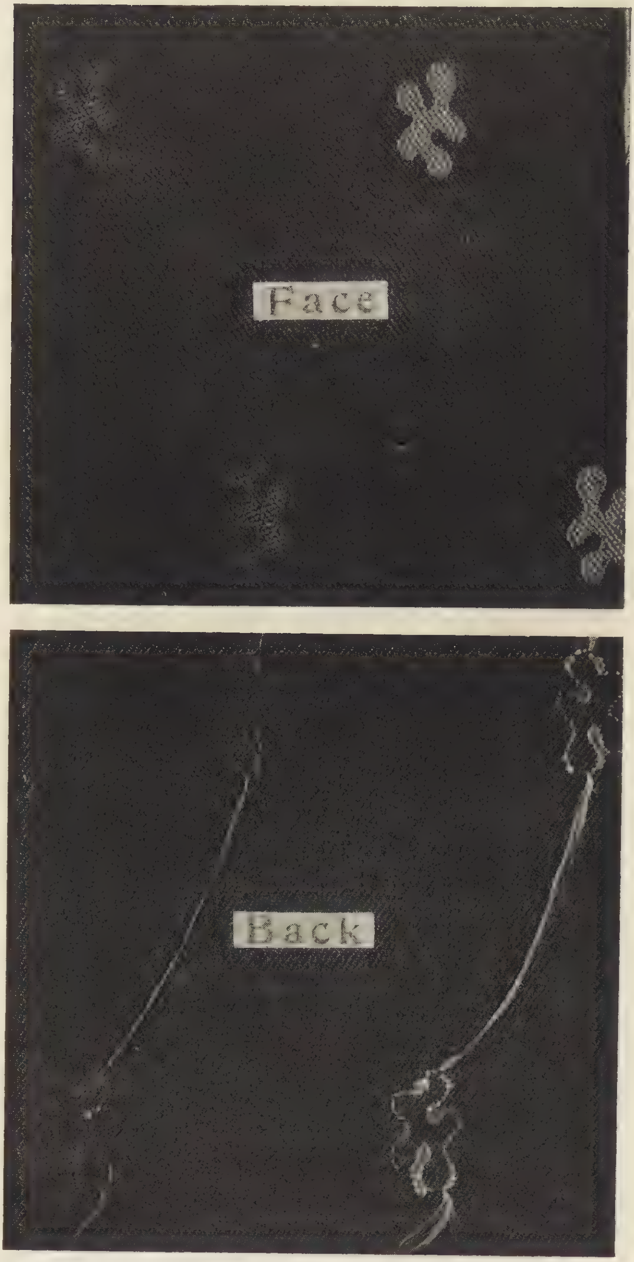


Fig. 457.—Showing the Face and Back of a Twill Fabric embellished with small detached figures produced by Swivel Weaving.

Swivel figuring is very easily distinguished from "lappet" figuring, by the interlacement of the extra figuring weft with warp ends, between the extreme edges of figure; and also by that weft bending around *warp ends* when returning at the edges of figure, and *not* around picks of weft, as in "lappet" figuring. During the operation of weaving, swivel-figured fabrics, like lappet-figured fabrics (produced by means of bottom needle-frames) are produced face downward, as represented in Fig. 457B. The auxiliary shuttles containing the figuring weft are of very different shape to that of ordinary loom shuttles; and, unlike the latter, they are not propelled separately and independently across the entire width of the loom; but in the prevailing type of swivel loom a number of them are carried simultaneously and positively through a corresponding number of sectional warp sheds formed at regular intervals apart across the width of cloth, for the purpose of inserting the extra figuring weft for the development of figure. The swivel shuttles, termed "poppets," are carried by, and move to and fro with, the sley, as the latter oscillates. They may be arranged in one, two, or more horizontal rows, or tiers (according to the number of colours of figuring weft required for the *same figure*) above the warp ends. Each tier may contain any practicable number of "poppet" shuttles, but with a corresponding number in each row. They are supported at regular intervals apart, in a frame termed the "poppet rack," which is capable of a vertical movement, to enable it to be alternately depressed and raised in a prescribed manner, in order to place any particular tier of "poppets" in a position to enter their respective sectional warp sheds, and insert picks of figuring weft. They are then passed simultaneously through the sheds, and quickly raised clear of the cloth to permit of the reed coming forward to beat up the short picks of weft which they have inserted. A shed is then formed all across the warp for the passage of the ordinary shuttle to insert an ordinary pick of weft for the foundation texture; after which, the sectional figuring sheds are again formed for the reception of figuring weft from the same or another tier of "poppets," according to the colour of weft required.

Woven Ondulé Effects.

§ 128. The term *ondulé* is used to distinguish an unusual and interesting variety of woven fabrics in which either warp ends or picks of weft are caused to assume undulating, wavy, or sinuous lines. An example of warp *ondulé* is represented by Fig. 458, which is reproduced from a specimen of cloth of this description. (It may be observed, incidentally, that the speci-

Selvedge

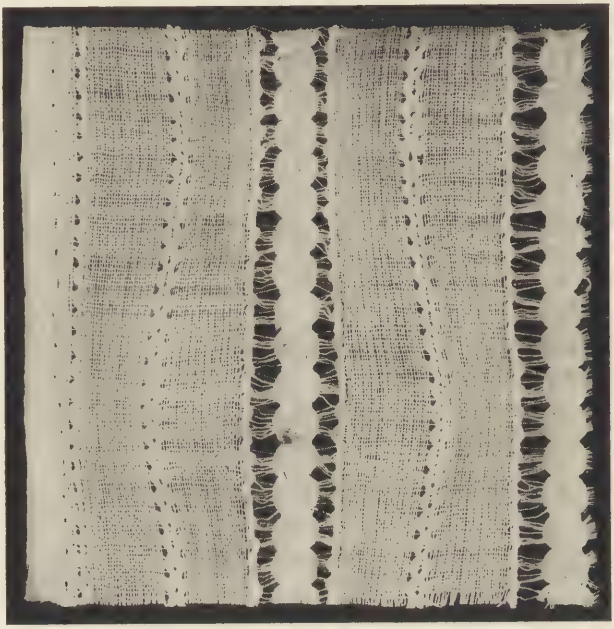


Fig. 458.—Warp Ondulé Fabric, with Net Leno and Cross-thread Lappet Stripes.

men here represented also embodies the principles of cross-weaving, in combination with lappet figuring, of the special variety described in § 125, and illustrated by Fig. 456, in which the whip or figuring threads cross each other in reverse directions.) Apart from the features just indicated in parentheses, there is nothing of an unusual structural character in the class of fabrics under consideration, which are generally

of simple construction. Their chief interest, therefore, lies in the special mechanical devices required for their production, which are sometimes of a novel and very ingenious character. When the undulations are required in the direction of warp ends, these devices consist essentially of some means whereby warp ends may be gradually spread apart and then closed in alternately, to produce contrary sinuous lines running lengthwise of the fabric. This may be achieved by either of two distinct methods. One method is to employ a reed, of which the dents may be contracted in some parts and expanded in others according to the effect desired; but a more approved and practical method of obtaining warp ondulé effects, however, is by means of what are variously termed "*paquet*," "*ondulé*," and *inverted* "*fan*" reeds, in which some of the reed wires are permanently inclined at

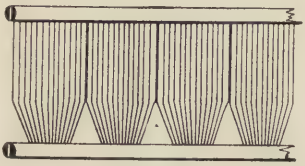


Fig. 459.

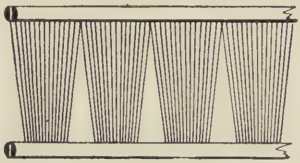


Fig. 460.

Ondulé, Paquet, or Fan Reeds, for the production of Warp Ondulé Effects.

gradually varying angles, and in opposite directions; albeit, they are all in the same vertical plane when viewed from the ends of the reed. Ondulé or paquet reeds are made in a great variety of forms according to the particular effect desired in cloth; and, during weaving, they are operated by auxiliary mechanism which slowly raises and depresses them alternately, thereby causing warp ends to gradually deviate from their normal straight course, and assume the characteristic undulating or sinuous lines. Three typical varieties of ondulé reeds are represented by Figs. 459, 460, and at R, Fig. 461. That shown in Fig. 461 is a common variety termed a double or inverted fan reed, for the production of regular and contrary sinuous lines; whilst those represented by Figs. 459 and 460 are designed to produce perforations in cloth. The intervals at which the perforations will occur both horizontally and vertically, in cloth, is determined

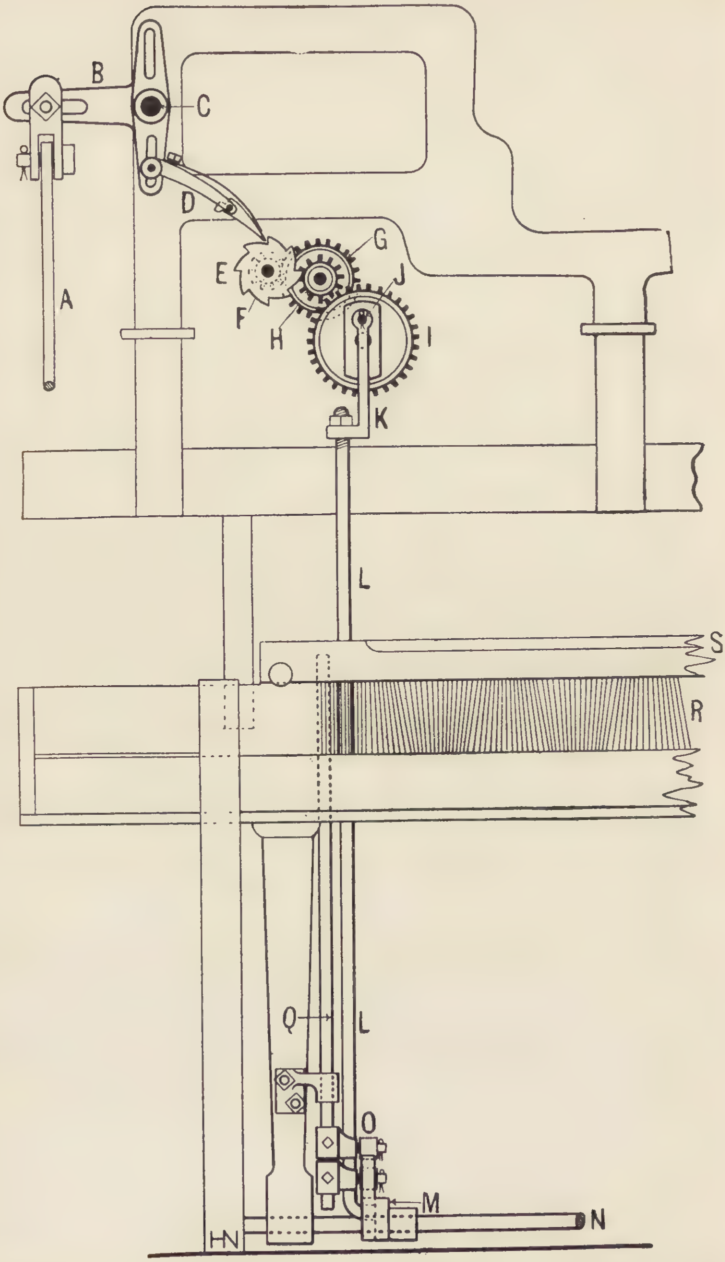


Fig. 461.—Part Front Elevation of a Loom adapted for the development of Warp Ondulé Effects by means of specially-designed Reeds, of which an example is represented at R.

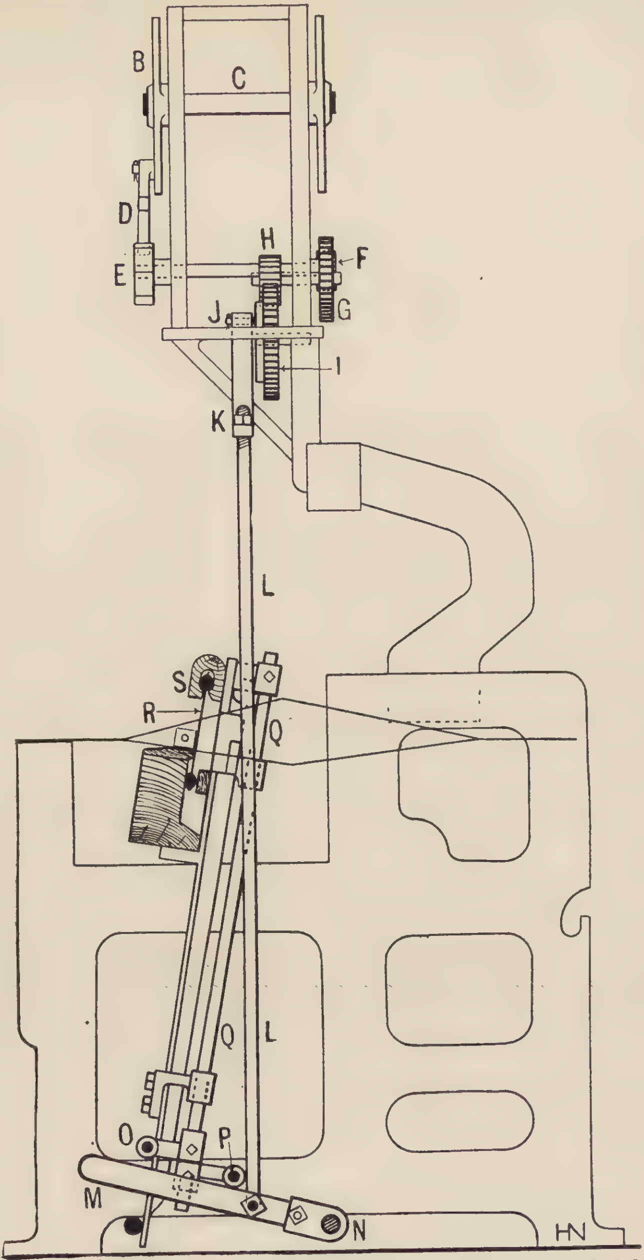


FIG. 462.—End Elevation of a Loom for the production of Warp Ondulé Effects.

by the distance between the gaps in the reed, and the velocity with which it is reciprocated, respectively. Some ondulé or paquet reeds are of a variegated character, with vertical dents alternated with dents inclined at various angles to the right and left, on each side of the vertical dents. They are also made in a variety of other forms according to requirements.

§ 129. A loom equipped with a device (invented by Mr. R. Foulds) for the development of ondulé effects, is represented in front and end elevation by Figs. 461 and 462 respectively. In this loom an inverted fan reed R is contained in a frame to which is imparted a slow reciprocal vertical and intermittent movement by means of a dobby acting through the medium of a train of wheels and suitable connections of rods and levers, as indicated in the diagrams. Mounted freely upon a stud or pin J, fixed in a wheel I, is a pendant arm K, from which is suspended a long rod L, with its lower end attached to a lever M, fixed to a cross bar N, on the opposite end of which is a duplicate lever M. Resting upon the respective levers M are two rods Q, which slide freely in brackets bolted to the sley swords, and therefore oscillate with the sley. The sley cap S, containing the upper ribs of the reed, is secured by means of brackets to the upper ends of rods Q, which are supported (at different times) by means of one or other of two arms, secured to their lower ends, and furnished with bowls or runners O, P, that rest upon their respective levers M. It will now be seen, therefore, that as wheel I is slowly and intermittently rotated, levers M will alternately rise and fall with a corresponding velocity, whereby different parts of the reed wires are brought opposite the fell of cloth *when beating up the weft*. Thus, in consequence of the angular disposition of reed wires, warp ends are congested or expanded in width, according as they pass through the congested or expanded extremities of the reed dents respectively.

The object of employing two runners O, P, placed at the ends of separate arms extending both forward and rearward of the respective rods Q, to which they are secured, is to cause the reed to assume a position midway between its highest and lowest elevations, during the formation of warp sheds, and thereby

prevent excessive chafing of warp ends that would otherwise be caused by their bearing hard and rubbing against the reed wires at the upper and lower extremities of a fan reed. This object is achieved in the following manner: As the sley oscillates, runners O and P are alternately brought to bear upon different parts of levers M, thereby causing the reed to either descend or ascend to a *neutral* position as the sley recedes, according to the upward or downward inclination (from the cross bar N) of levers M, respectively.

Weft Ondulé Effect.

§ 130. An exceptional and interesting specimen of cloth of the ondulé variety is photographically represented by Fig. 463. This example may be described as a weft, or cross-over ondulé effect, since they are *picks of weft* and not warp ends, that assume a wavy character (as indicated by the selvedge, on the left of the fabric). This example is produced from organzine silk warp picked with genapped worsted, to produce a light muslin texture of the plain or calico weave, suitable for a summer dress material.

A weft ondulé effect may be developed in a variety of ways, either by means of shaped reeds expressly designed to produce the required effect in cloth; or by applying a constantly varying degree of tension to alternate groups of warp ends. Reeds, styled "Erdmann" reeds (after their inventor), are either constructed of shaped wires placed vertically, so as to appear curved on their front edge when the reed is viewed end-wise; or the wires may be straight and arranged at varying angles, so that if the reed were viewed end-wise, they would appear to cross each other like the letters **V** or **X**; and if viewed in plan, they would form a serpentine or undulating line from end to end of the reed. By slowly and alternately raising and depressing such reeds, the picks of weft will assume varying degrees of undulation according to the velocity with which the reed is vertically reciprocated. By keeping the reed stationary at any given point, picks may be inserted uniformly parallel with each

other, either straight, or in more or less undulating lines, as required.

§ 131. Weft ondulé effects may be produced in looms furnished with ordinary reeds, by dividing warp ends (immediately after leaving the warp beam) into groups according to the length of wave required, and by passing alternate groups of threads over one bar, and intermediate groups over a second bar. By slowly

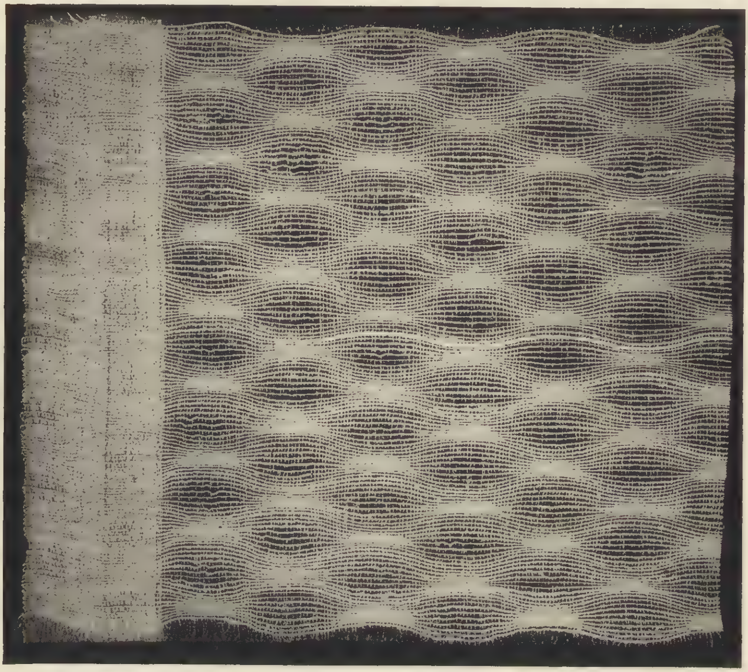


FIG. 463.—Weft Ondulé Fabric.

oscillating both bars in contrary directions (by means of cams, cranks or eccentrics) a gradually varying degree of tension will be imparted to warp ends, whereby the two divisions of threads will be alternately tautened and slackened. This will cause the picks of weft to assume more or less wavy lines, according to the disparity between the tension of the two divisions of threads. An alternative, though less practical method of obtaining a

similar result would be to wind the two divisions of threads upon separate warp beams, and, by any suitable means, apply varying degrees of resistance to the withdrawal of yarn from them, and thereby alternately increase and diminish the tension of the two divisions of warp ends in a contrary manner.

Looped Fabrics.

§ 132. A variety of fabrics in vogue as dress materials are formed with a series of loops either sparsely distributed, or arranged in stripes, on the face side of the cloth only. The loops are developed by means of extra warp ends, upon a foundation texture of simple construction. The extra warp ends require to be wound upon a separate warp beam, which is very lightly weighted, to permit the threads to be freely withdrawn when required to form loops. Fabrics of this class are but very remotely, if at all, related to the well-known type of terry pile fabrics described in Chapter VIII., as they neither embody the same principles of construction, nor is it essential to employ a terry motion to produce the loops—although loops are sometimes formed in these fabrics by causing the reed to recede for certain picks, and to be held fast in its normal position for others, in a manner similar to that which obtains in terry weaving (as described in § 82), excepting that the liberation of the reed is effected by means of the dobby (if such is employed), or by other improvised contrivance, to save the expense of a loom equipped with a special terry motion. The prevailing method, however, of forming loops in this variety of fabrics is to pass the required warp ends between two cloth-covered rollers which are rotated intermittently, to deliver uniform lengths of warp according to the size of loops required to be formed on the fabric, and to weave without the reed being allowed to swing backward at the bottom, from its normal position, as the sley advances to beat up picks of weft.

INDEX.

A.

B.

C.

D.

E.

F.

G.

H.

I.

L.

M.

N.

O.

P.

R.

S.

T.

V.

W.

Y.

Z.

THE ABERDEEN UNIVERSITY PRESS LIMITED.

Catalogue
OF
Special Technical Books
FOR
MANUFACTURERS, TECHNICAL STUDENTS AND WORKERS, SCHOOLS, COLLEGES, ETC.
BY EXPERT WRITERS

INDEX TO SUBJECTS.

PUBLISHED BY

SCOTT, GREENWOOD & SON,

8 BROADWAY, LUDGATE HILL,

LONDON, E.C.

Telephone, Bank 5403. Telegraphic Address, "Printeries, London".

Paints, Colours and Printing Inks.

THE CHEMISTRY OF PIGMENTS. By ERNEST J. PARRY, B.Sc. (Lond.), F.I.C., F.C.S., and J. H. COSTE, F.I.C., F.C.S. Demy 8vo. Five Illustrations. 285 pp. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. 3d. abroad.)

Contents.

Introductory. Light—White Light—The Spectrum—The Invisible Spectrum—Normal Spectrum—Simple Nature of Pure Spectral Colour—The Recomposition of White Light—Primary and Complementary Colours—Coloured Bodies—Absorption Spectra—**The Application of Pigments.** Uses of Pigments: Artistic, Decorative, Protective—Methods of Application of Pigments: Pastels and Crayons, Water Colour, Tempera Painting, Fresco, Encaustic Painting, Oil-colour Painting, Keramic Art, Enamel, Stained and Painted Glass, Mosaic—**Inorganic Pigments.** White Lead—Zinc White—Enamel White—Whitening—Red Lead—Litharge—Vermilion—Royal Scarlet—The Chromium Greens—Chromates of Lead, Zinc, Silver and Mercury—Brunswick Green—The Ochres—Indian Red—Venetian Red—Siennas and Umbers—Light Red—Cappagh Brown—Red Oxides—Mars Colours—Terre Verte—Prussian Brown—Cobalt Colours—Cœruleum—Smalt—Copper Pigments—Malachite—Bremen Green—Scheele's Green—Emerald Green—Verdigris—Brunswick Green—Non-arsenical Greens—Copper Blues—Ultramarine—Carbon Pigments—Ivory Black—Lamp Black—Bistre—Naples Yellow—Arsenic Sulphides: Orpiment, Realgar—Cadmium Yellow—Vandyck Brown—**Organic Pigments.** Prussian Blue—Natural Lakes—Cochineal—Carmine—Crimson—Lac Dye—Scarlet—Madder—Alizarin—Campeachy—Quercitron—Rhamnus—Brazil Wood—Alkanet—Santal Wood—Archil—Coal-tar Lakes—Red Lakes—Alizarin Compounds—Orange and Yellow Lakes—Green and Blue Lakes—Indigo—Dragon's Blood—Gamboge—Sepia—Indian Yellow, Puree—Bitumen, Asphaltum, Mummy—**Index.**

THE MANUFACTURE OF PAINT. A Practical Handbook for Paint Manufacturers, Merchants and Painters. By J. CRUICKSHANK SMITH, B.Sc. Demy 8vo. 200 pp. Sixty Illustrations and One Large Diagram. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Preparation of Raw Material—Storing of Raw Material—Testing and Valuation of Raw Material—Paint Plant and Machinery—The Grinding of White Lead—Grinding of White Zinc—Grinding of other White Pigments—Grinding of Oxide Paints—Grinding of Staining Colours—Grinding of Black Paints—Grinding of Chemical Colours—Yellows—Grinding of Chemical Colours—Blues—Grinding Greens—Grinding Reds—Grinding Lakes—Grinding Colours in Water—Grinding Colours in Turpentine—The Uses of Paint—Testing and Matching Paints—Economic Considerations—Index.

DICTIONARY OF CHEMICALS AND RAW PRODUCTS USED IN THE MANUFACTURE OF PAINTS, COLOURS, VARNISHES AND ALLIED PREPARATIONS. By GEORGE H. HURST, F.C.S. Demy 8vo. 380 pp. Price 7s. 6d. net. (Post free, 8s. home; 8s. 6d. abroad.)

THE MANUFACTURE OF LAKE PIGMENTS FROM ARTIFICIAL COLOURS. By FRANCIS H. JENNISON, F.I.C., F.C.S. **Sixteen Coloured Plates, showing Specimens of Eighty-nine Colours, specially prepared from the Recipes given in the Book.** 136 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

The Groups of the Artificial Colouring Matters—The Nature and Manipulation of Artificial Colours—Lake-forming Bodies for Acid Colours—Lake-forming Bodies' Basic Colours—Lake Bases—The Principles of Lake Formation—Red Lakes—Orange, Yellow, Green, Blue, Violet and Black Lakes—The Production of Insoluble Azo Colours in the Form of Pigments—The General Properties of Lakes Produced from Artificial Colours—Washing, Filtering and Finishing—Matching and Testing Lake Pigments—Index

PAINTS, COLOURS, ETC.—*continued.*

THE MANUFACTURE OF MINERAL AND LAKE PIGMENTS. Containing Directions for the Manufacture of all Artificial, Artists and Painters' Colours, Enamel, Soot and Metallic Pigments. A Text-book for Manufacturers, Merchants, Artists and Painters. By Dr. JOSEF BERSCH. Translated by A. C. WRIGHT, M.A. (Oxon.), B.Sc. (Lond.). Forty-three Illustrations. 476 pp., demy 8vo. Price 12s. 6d. net. (Post free, 13s. home; 13s. 6d. abroad.)

Contents.

Introduction—Physico-chemical Behaviour of Pigments—Raw Materials Employed in the Manufacture of Pigments—Assistant Materials—Metallic Compounds—The Manufacture of Mineral Pigments—The Manufacture of White Lead—Enamel White—Washing Apparatus—Zinc White—Yellow Mineral Pigments—Chrome Yellow—Lead Oxide Pigments—Other Yellow Pigments—Mosaic Gold—Red Mineral Pigments—The Manufacture of Vermilion—Antimony Vermilion—Ferric Oxide Pigments—Other Red Mineral Pigments—Purple of Cassius—Blue Mineral Pigments—Ultramarine—Manufacture of Ultramarine—Blue Copper Pigments—Blue Cobalt Pigments—Smalts—Green Mineral Pigments—Emerald Green—Verdigris—Chromium Oxide—Other Green Chromium Pigments—Green Cobalt Pigments—Green Manganese Pigments—Compounded Green Pigments—Violet Mineral Pigments—Brown Mineral Pigments—Brown Decomposition Products—Black Pigments—Manufacture of Soot Pigments—Manufacture of Lamp Black—The Manufacture of Soot Black without Chambers—Indian Ink—Enamel Colours—Metallic Pigments—Bronze Pigments—Vegetable Bronze Pigments.

PIGMENTS OF ORGANIC ORIGIN—Lakes—Yellow Lakes—Red Lakes—Manufacture of Carmine—The Colouring Matter of Lac—Safflower or Carthamine Red—Madder and its Colouring Matters—Madder Lakes—Manjit (Indian Madder)—Lichen Colouring Matters—Red Wood Lakes—The Colouring Matters of Sandal Wood and Other Dye Woods—Blue Lakes—Indigo Carmine—The Colouring Matter of Log Wood—Green Lakes—Brown Organic Pigments—Sap Colours—Water Colours—Crayons—Confectionery Colours—The Preparation of Pigments for Painting—The Examination of Pigments—Examination of Lakes—The Testing of Dye-Woods—The Design of a Colour Works—Commercial Names of Pigments—Appendix: Conversion of Metric to English Weights and Measures—Centigrade and Fahrenheit Thermometer Scales—Index.

RECIPES FOR THE COLOUR, PAINT, VARNISH, OIL, SOAP AND DRYSALTERY TRADES. Compiled by AN ANALYTICAL CHEMIST. 350 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 8s. home; 8s. 3d. abroad.)

Contents.

Pigments or Colours for Paints, Lithographic and Letterpress Printing Inks, etc.—Mixed Paints and Preparations for Paint-making, Painting, Lime-washing, Paperhanging, etc.—Varnishes for Coach-builders, Cabinetmakers, Wood-workers, Metal-workers, Photographers, etc.—Soaps for Toilet, Cleansing, Polishing, etc.—Perfumes—Lubricating Greases, Oils, etc.—Cements, Pastes, Glues and Other Adhesive Preparations—Writing, Marking, Endorsing and Other Inks—Sealing-wax and Office Requisites—Preparations for the Laundry, Kitchen, Stable and General Household Uses—Disinfectant Preparations—Miscellaneous Preparations—Index.

OIL COLOURS AND PRINTERS' INKS. By LOUIS EDGAR ANDÉS. Translated from the German. 215 pp. Crown 8vo. 56 Illustrations. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

Linseed Oil—Poppy Oil—Mechanical Purification of Linseed Oil—Chemical Purification of Linseed Oil—Bleaching Linseed Oil—Oxidizing Agents for Boiling Linseed Oil—Theory of Oil Boiling—Manufacture of Boiled Oil—Adulterations of Boiled Oil—Chinese Drying Oil and Other Specialities—Pigments for House and Artistic Painting and Inks—Pigment for Printers' Black Inks—Substitutes for Lampblack—Machinery for Colour Grinding and Rubbing—Machines for mixing Pigments with the Vehicle—Paint Mills—Manufacture of House Oil Paints—Ship Paints—Luminous Paint—Artists' Colours—Printers' Inks:—VEHICLES—Printers' Inks:—PIGMENTS and MANUFACTURE—Index.

(*See also Writing Inks*, *p.* 11.)

THREE HUNDRED SHADES AND HOW TO MIX THEM. For Architects, Decorators and Painters.

(*See page* 28.)

PAINTS, COLOURS, ETC.—*continued.*

CASEIN. By ROBERT SCHERER. Translated from the German by CHAS. SALTER. Demy 8vo. Illustrated. 160 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Casein: its Origin, Preparation and Properties. Various Methods of Preparing Casein. Composition and Properties of Casein. Casein Paints.—"Marble-Lime" Colour for Outside Work—Casein Enamel Paint—Casein Façade Paint—Cold-Water Paint in Powder Form—Kistory's Recipe for Casein Paint and Varnish—Pure Casein Paints for Walls, etc.—Casein Paints for Woodwork and Iron—Casein-Silicate Paints—Milk Paints—Casein-Silicate Paint Recipes—Trojel's Boiled Oil Substitute—Calsomine Wash—Quick-Drying Casein Paint—Boiled Oil Substitute—Ring's Cold-Water Paint—Formolactin—Waterproof Paint for Playing Cards—Casein Colour Lake—Casein-Cement Paint. **The Technics of Casein Painting. Casein Adhesives and Putties.**—Casein Glue in Plates or Flakes—Jeromin's Casein Adhesive—Hall's Casein Glue—Waterproof Glue—Liquid Casein Glue—Casein and Borax Glue—Solid Casein Adhesive—Casein Solution—Glue Powder—Casein Putties—Washable Cement for Deal Boards—Wenk's Casein Cement—Casein and Lime Cement—"Pitch Barm"—Casein Stopping—Casein Cement for Stone. **The Preparation of Plastic Masses from Casein.**—Imitation Ivory—Anti-Radiation and Anti-Corrosive Composition—Dickmann's Covering for Floors and Walls—Imitation Linoleum—Imitation Leather—Imitation Bone—Plastic Mass of Keratin and Casein—Insulating Mass—Plastic Casein Masses—Horny Casein Mass—Plastic Mass from Celluloid—Casein Cellulose Composition—Fireproof Cellulose Substitute—Nitrocellulose and Casein Composition—Franquet's Celluloid Substitute—Galalith. **Uses of Casein in the Textile Industry, for Finishing Colour Printing, etc.**—Caseogum—"Glutin"—Casein Dressing for Linen and Cotton Fabrics—Printing Colour with Metallic Lustre—Process for Softening, Sizing and Loading—Fixing Casein and Other Albuminoids on the Fibre—Fixing Insoluble Colouring Matters—Waterproofing and Softening Dressing—Casein for Mercerising Crêpe—Fixing Zinc White on Cotton with Formaldehyde—Casein-Magnesia—Casein Medium for Calico Printing—Loading Silk. **Casein Foodstuffs.**—Casein Food—Synthetic Milk—Milk Food—Emulsifiable Casein—Casein Phosphate for Baking—Making Bread, Low in Carbohydrates, from Flour and Curd—Preparing Soluble Casein Compounds with Citrates—Casein Food. **Sundry Applications of Casein.**

SIMPLE METHODS FOR TESTING PAINTERS' MATERIALS. By A. C. WRIGHT, M.A. (Oxon.), B.Sc. (Lond.). Crown 8vo. 160 pp. Price 5s. net. (Post free, 5s. 3d. home; 5s. 6d. abroad.)

IRON - CORROSION, ANTI - FOULING AND ANTI-CORROSIVE PAINTS. Translated from the German of LOUIS EDGAR ANDÉS. Sixty-two Illustrations. 275 pp. Demy 8vo. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. 3d. abroad.)

Contents.

Iron-rust and its Formation—Protection from Rusting by Paint—Grounding the Iron with Linseed Oil, etc.—Testing Paints—Use of Tar for Painting on Iron—Anti-corrosive Paints—Linseed Varnish—Chinese Wood Oil—Lead Pigments—Iron Pigments—Artificial Iron Oxides—Carbon—Preparation of Anti-corrosive Paints—Results of Examination of Several Anti-corrosive Paints—Paints for Ship's Bottoms—Anti-fouling Compositions—Various Anti-corrosive and Ship's Paints—Official Standard Specifications for Ironwork Paints—Index.

THE TESTING AND VALUATION OF RAW MATERIALS USED IN PAINT AND COLOUR MANUFACTURE. By M. W. JONES, F.C.S. A Book for the Laboratories of Colour Works. 88 pp. Crown 8vo. Price 5s. net. (Post free, 5s. 3d. home and abroad.)

THE MANUFACTURE AND COMPARATIVE MERITS OF WHITE LEAD AND ZINC WHITE PAINTS. By G. PETIT, Civil Engineer, etc. Translated from the French. Crown 8vo. 100 pp. Price 4s. net. (Post free, 4s. 3d. home; 4s. 4d. abroad.)

Contents.

Chapters I., The Fundamental Principles of Painting in Oil. II., The Different Varieties of White Leads—The Dutch Process—Grinding White Lead in Oil. III., Other Processes of Manufacturing White Lead. IV., White Lead Substitutes—Sophistication of White Lead—Analysis of White Lead. V., White Lead Paints—Their Merits and Defects. VI., Toxicology of White Lead—Hygienic Measures in its Manufacture and Use. VII., Zinc White—Its Preparation. IX. Zinc White Paint and Zinc White Coatings—Their Merits and Defects.

STUDENTS' HANDBOOK OF PAINTS, COLOURS, OILS AND VARNISHES. By JOHN FURNELL. Crown 8vo. 12 Illustrations. 96 pp. Price 2s. 6d. net. (Post free, 2s. 9d. home and abroad.)

Varnishes and Drying Oils.

OIL CRUSHING, REFINING AND BOILING, THE MANUFACTURE OF LINOLEUM, PRINTING AND LITHOGRAPHIC INKS, AND INDIA-RUBBER SUBSTITUTES. By JOHN GEDDES MCINTOSH. Being Volume I. of the Second, greatly enlarged, English Edition, in three Volumes, of "The Manufacture of Varnishes and Kindred Industries," based on and including the work of Ach. Livache. Demy 8vo. 150 pp. 29 Illustrations. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

VARNISHES AND VARNISH MAKING MATERIALS. By J. G. MCINTOSH. Demy 8vo. 54 Illustrations. [*In the Press.*

Contents.

Chapter I., Introduction. II., Amber and Amber Oil Varnishes. III., Copal, etc. IV., **Resins**—Assorting, Cleaning and Fusing. V., Asphaltum, Coal-Tar, Pitch, Rubber, etc. VI., Oil-Varnish Making—General Instructions. VII., Copal Oil Varnish. VIII., Rosin Oil Varnish—Brunswick Black—Super Black Japan. IX., Testing Varnish—Utilisation of Residues.

DRYING OILS, BOILED OIL AND SOLID AND LIQUID DRIERS. By L. E. ANDÉS. Expressly Written for this Series of Special Technical Books, and the Publishers hold the Copyright for English and Foreign Editions. Forty-two Illustrations. 342 pp. Demy 8vo. Price 12s. 6d. net. (Post free, 13s. home; 13s. 3d. abroad.)

Contents.

Properties of the Drying Oils; Cause of the Drying Property; Absorption of Oxygen; Behaviour towards Metallic Oxides, etc.—The Properties of and Methods for obtaining the Drying Oils—Production of the Drying Oils by Expression and Extraction; Refining and Bleaching; Oil Cakes and Meal; The Refining and Bleaching of the Drying Oils; The Bleaching of Linseed Oil—The Manufacture of Boiled Oil; The Preparation of Drying Oils for Use in the Grinding of Paints and Artists' Colours and in the Manufacture of Varnishes by Heating over a Fire or by Steam, by the Cold Process, by the Action of Air, and by Means of the Electric Current; The Driers used in Boiling Linseed Oil; The Manufacture of Boiled Oil and the Apparatus therefor; Livache's Process for Preparing a Good Drying Oil and its Practical Application—The Preparation of Varnishes for Letterpress, Lithographic and Copperplate Printing, for Oilcloth and Waterproof Fabrics; The Manufacture of Thickened Linseed Oil, Burnt Oil, Stand Oil by Fire Heat, Superheated Steam, and by a Current of Air—Behaviour of the Drying Oils and Boiled Oils towards Atmospheric Influences, Water, Acids and Alkalies—Boiled Oil Substitutes—The Manufacture of Solid and Liquid Driers from Linseed Oil and Rosin; Linolic Acid Compounds of the Driers—The Adulteration and Examination of the Drying Oils and Boiled Oil.

Oils, Fats, Greases, Petroleum.

LUBRICATING OILS, FATS AND GREASES: Their Origin, Preparation, Properties, Uses and Analyses. A Handbook for Oil Manufacturers, Refiners and Merchants, and the Oil and Fat Industry in General. By GEORGE H. HURST, F.C.S. Second Revised and Enlarged Edition. Sixty-five Illustrations. 317 pp. Demy 8vo. Price 10s. 6d. net. (Post free, 11s. home; 11s. 3d. abroad.)

Contents.

Introductory—Hydrocarbon Oils—Scotch Shale Oils—Petroleum—Vegetable and Animal Oils—Testing and Adulteration of Oils—Lubricating Greases—Lubrication—Appendices—Index.

TECHNOLOGY OF PETROLEUM: Oil Fields of the World—Their History, Geography and Geology—Annual Production and Development—Oil-well Drilling—Transport. By HENRY NEUBERGER and HENRY NOALHAT. Translated from the French by J. G. MCINTOSH. 550 pp. 153 Illustrations. 26 Plates. Super Royal 8vo. Price 21s. net. (Post free, 21s. 9d. home; 23s. 6d. abroad.)

Contents.

Study of the Petroliferous Strata.
Excavations—Hand Excavation or Hand Digging of Oil Wells.
Methods of Boring.
Accidents—Boring Accidents—Methods of preventing them—Methods of remedying them—Explosives and the use of the "Torpedo" Levigation—Storing and Transport of Petroleum—General Advice—Prospecting, Management and carrying on of Petroleum Boring Operations.
General Data—Customary Formulæ—Memento. Practical Part. General Data bearing on Petroleum—Glossary of Technical Terms used in the Petroleum Industry—Copious Index.

THE PRACTICAL COMPOUNDING OF OILS, TALLOW AND GREASE FOR LUBRICATION, ETC. By AN EXPERT OIL REFINER. Second Edition. 100 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Introductory Remarks on the General Nomenclature of Oils, Tallow and Greases suitable for Lubrication—**Hydrocarbon Oils—Animal and Fish Oils—Compound Oils—Vegetable Oils—Lamp Oils—Engine Tallow, Solidified Oils and Petroleum Jelly—Machinery Greases: Loco and Anti-friction—Clarifying and Utilisation of Waste Fats, Oils, Tank Bottoms, Drainings of Barrels and Drums, Pickings Up, Dregs, etc.—The Fixing and Cleaning of Oil Tanks, etc.—Appendix and General Information.**

ANIMAL FATS AND OILS: Their Practical Production Purification and Uses for a great Variety of Purposes. Their Properties, Falsification and Examination. Translated from the German of LOUIS EDGAR ANDÉS. Sixty-two Illustrations. 240 pp. Second Edition, Revised and Enlarged. Demy 8vo. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. 3d. abroad.)

Contents.

Introduction—Occurrence, Origin, Properties and Chemical Constitution of Animal Fats—Preparation of Animal Fats and Oils—Machinery—Tallow-melting Plant—Extraction Plant—Presses—Filtering Apparatus—Butter: Raw Material and Preparation, Properties, Adulterations, Beef Lard or Remelted Butter, Testing—Candle-fish Oil—Mutton-Tallow—Hare Fat—Goose Fat—Neatsfoot Oil—Bone Fat: Bone Boiling, Steaming Bones, Extraction, Refining—Bone Oil—Artificial Butter: Oleomargarine, Margarine Manufacture in France, Grasso's Process, "Kaiser's Butter," Jahr & Münzberg's Method, Filbert's Process, Winter's Method—Human Fat—Horse Fat—Beef Marrow—Turtle Oil—Hog's Lard: Raw Material—Preparation, Properties, Adulterations, Examination—Lard Oil—Fish Oils—Liver Oils—Artificial Train Oil—Wool Fat: Properties, Purified Wool Fat—Spermaceti: Examination of Fats and Oils in General.

THE MANUFACTURE OF LUBRICANTS, SHOE POLISHES AND LEATHER DRESSINGS. By RICHARD BRUNNER. Translated from the Sixth German Edition by CHAS. SALTER. 10 Illustrations. Crown 8vo. 170 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

The Manufacture of Lubricants and Greases—Properties of the Bodies used as Lubricants—Raw Materials for Lubricants—Solid Lubricants—Tallow Lubricants—Palm Oil Greases—Lead Soap Lubricants—True Soap Greases—Caoutchouc Lubricants—Other Solid Lubricants—Liquid Lubricants—Lubricating Oils in General—Refining Oils for Lubricating Purposes—Cohesion Oils—Resin Oils—Lubricants of Fat and Resin Oil—Neatsfoot Oil—Bone Fat—Lubricants for Special Purposes—Mineral Lubricating Oils—Clockmakers' and Sewing Machine Oils—The Application of Lubricants to Machinery—Removing Thickened Grease and Oil—Cleaning Oil Rags and Cotton Waste—The Use of Lubricants—Shoe Polishes and Leather Softening Preparations—The Manufacture of Shoe Polishes and Preparations for Varnishing and Softening Leather—The Preparation of Bone Black—Blacking and Shoe Polishes—Leather Varnishes—Leather Softening Preparations—The Manufacture of Dégras.

THE OIL MERCHANTS' MANUAL AND OIL TRADE READY RECKONER. Compiled by FRANK F. SHERRIFF. Second Edition Revised and Enlarged. Demy 8vo. 214 pp. 1904. With Two Sheets of Tables. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. 3d. abroad.)

Contents.

Trade Terms and Customs—Tables to Ascertain Value of Oil sold per cwt. or ton—Specific Gravity Tables—Percentage Tare Tables—Petroleum Tables—Paraffine and Benzoline Calculations—Customary Drafts—Tables for Calculating Allowance for Dirt, Water, etc.—Capacity of Circular Tanks Tables, etc., etc.

VEGETABLE FATS AND OILS: Their Practical Preparation, Purification and Employment for Various Purposes, their Properties, Adulteration and Examination. Translated from the German of LOUIS EDGAR ANDÉS. Ninety-four Illustrations. 340 pp. Second Edition. Demy 8vo. Price 10s. 6d. net. (Post free, 11s. home; 11s. 6d. abroad.)

Essential Oils and Perfumes.

THE CHEMISTRY OF ESSENTIAL OILS AND ARTIFICIAL PERFUMES. By ERNEST J. PARRY, B.Sc. (Lond.), F.I.C., F.C.S. 411 pp. 20 Illustrations. Demy 8vo. Price 12s. 6d. net. (Post free, 13s. home; 13s. 6d. abroad.)

Contents.

The General Properties of Essential Oils—Compounds occurring in Essential Oils—The Preparation of Essential Oils—The Analysis of Essential Oils—Systematic Study of the Essential Oils—Terpeneless Oils—The Chemistry of Artificial Perfumes—Appendix: Table of Constants—**Index.**

Soaps.

SOAPS. A Practical Manual of the Manufacture of Domestic, Toilet and other Soaps. By GEORGE H. HURST, F.C.S. 2nd edition. 390 pp. 66 Illustrations. Price 12s. 6d. net. (Post free, 13s. home; 13s. 6d. abroad.)

Contents.

Introductory—Soap-maker's Alkalies—Soap Fats and Oils—Perfumes—Water as a Soap Material—Soap Machinery—Technology of Soap-making—Glycerine in Soap Lyes—Laying out a Soap Factory—Soap Analysis—Appendices.

TEXTILE SOAPS AND OILS. Handbook on the Preparation, Properties and Analysis of the Soaps and Oils used in Textile Manufacturing, Dyeing and Printing. By GEORGE H. HURST, F.C.S. Crown 8vo. 195 pp. 1904. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

SOAPS: THEIR MANUFACTURE AND ANALYSIS. By WM. H. SIMMONS, B.Sc. (Lond.), F.C.S. and H. A. APPLETON.

[*In Preparation.*

Contents.

Chapters I. Introduction.—Definition and Nature of Soap—Its Action as a Detergent—Views of Berzelius, Persoz, Rotondi, Carpenter, and Hillyer. **II. Constitution of Fats and Oils and their Saponification.**—Researches of Chevreul and Liebig—Modern Theories of Hydrolysis—Saponification by (1) *Ferments:* Lipase, Steapsin, Emulsion, Castor Seed Ferment; (2) *Water;* (3) *Accelerators:* Hydrochloric Acid, Sulphuric Acid, Twitchell's Reagent; (4) *Bases* (*a*) Without Pressure, (*b*) With Pressure, Lime, Magnesia, Zinc Oxide. **III. Raw Materials Used in Soap-making.**—Tallow—Australian, North and South American (Beef and Mutton), Oleostearine, Home-melted or Town Tallow—Lard—Cocoanut Oil (Cochin, Ceylon, Coprah, Pressed)—Palm Kernöl Oil—Olive Oil—Olive Kernöl—Cottonseed Oil—Cottonseed Stearin—Arachis—Sesame—Linseed—Castor—Waste Fats (*a*) Bone Fat, (*b*) Kitchen Fat (Melted Stuff)—Fatty Acids—Stearines from Recovered Oils and Greases—Rosin—Shew Butter—Mowrah Oil—Vegetable Tallow—Various New Fats Offered—Alkali (Caustic and Carbonate Soda and Potash)—Silicate of Soda—Chloride of Soda—Water. **IV. Bleaching and Treatment of Oils Intended for Soap-Making.**—Bleaching Crude Palm Oil—Washing Tallows—Refining Crude Cottonseed Oil—Mechanical Methods of Purification—Treatment with Ozone, Hydrogen Peroxide, Sodium Peroxide, etc. **V. Soap-Making.**—Classification of Soaps—Direct Combination of Fatty Acids with Alkali—Cold Process Soaps—Saponification under Pressure—Soft Soap—Hydrated Marine Soap—Curd

Soap—Castile Soap—Milling Soap Base—Yellow Household Soaps—Mottled Soaps—Graining Out—Boiling on Strength—"Fitting"—Resting for Subsidence of Nigres, Lyes, etc.—Utilisation and Bleaching of Nigres. **VI. Household and "Boiled" Toilet Soaps.** —Cleansing—Crutching—Liquoring of Soaps—Neutralising, Colouring and Perfuming Unmilled Toilet Soaps—Medicating Disinfectant Soaps—Framing—Slabbing and Barring—Drying—Open and Close Piling—Stamping. **VII. Milled Toilet Soaps.**—Drying—Milling—Incorporation of Colour and Perfume—Compressing, Stamping—Wrapping and Packing—Transparent and Semi-transparent Soaps—Albumen Soaps—Milk, Egg and Vegetable Albumen. **VIII. Essential Oils and Synthetic Perfumes.**—General Remarks—Anisi—Aspic—Bay—Bergamot—Bitter Almonds—Canada Snake Root—Cananga—Caraway—Cassia—Cedarwood—Cinnamon—Citronella—Clove—Eucalyptus—Fennel—Geranium—Gingergrass—Guaiac Wood—Lavender—Lemon—Lime—Linalot—Marjoram—Nexoli—Orange—Orris Concrete—Palmarosa—Patchouli—Perpermint—Peru Balsam—Petitgrain—Pimento—Rose—Rosemary—Sage—Sandalwood—Sassafras—Thyme Rouge—Verbena—Vetivert—Wintergreen—Ylang-ylang—Antipine—Conmarine—Heliotropin—Ionone—Mirbane—Musk—Niobi—Terebene—Terpineol—Vanillan. **IX. Medicated Soaps and Shaving Creams.**—Addition of Medicaments—Borax—Carbolic—Birch Tar—Ichthyöl—Lysol—Mercury Liniodide—Formalin—Thymol, etc. **X. Industrial Soaps.**—Textile Soaps—Miscellaneous Soaps—Marking Soaps. **XI. Recovery of Glycerine from Lyes.**—Treatment—Concentration—Purification and Distillation. **XII. Analysis of Soap and Other Products.**—Methods of Analysis—Comparative Valuation of Soaps—Typical Analysis. **XIII. Statistics of Soap Industry.**—Imports and Exports.

Cosmetical Preparations.

COSMETICS: MANUFACTURE, EMPLOYMENT AND TESTING OF ALL COSMETIC MATERIALS AND COSMETIC SPECIALITIES. Translated from the German of Dr. THEODOR KOLLER. Crown 8vo. 262 pp. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

Purposes and Uses of, and Ingredients used in the Preparation of Cosmetics—Preparation of Perfumes by Pressure, Distillation, Maceration, Absorption or Enfleurage, and Extraction Methods—Chemical and Animal Products used in the Preparation of Cosmetics—Oils and Fats used in the Preparation of Cosmetics—General Cosmetic Preparations—Mouth Washes and Tooth Pastes—Hair Dyes, Hair Restorers and Depilatories—Cosmetic Adjuncts and Specialities—Colouring Cosmetic Preparations—Antiseptic Washes and Soaps—Toilet and Hygienic Soaps—Secret Preparations for Skin, Complexion, Teeth, Mouth, etc.—Testing and Examining the Materials Employed in the Manufacture of Cosmetics—Index.

Glue, Bone Products and Manures.

GLUE AND GLUE TESTING. By SAMUEL RIDEAL, D.Sc. (Lond.), F.I.C. Fourteen Engravings. 144 pp. Demy 8vo. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. abroad.)

Contents.

Constitution and Properties: Definitions and Sources, Gelatine, Chondrin and Allied Bodies, Physical and Chemical Properties, Classification, Grades and Commercial Varieties. —**Raw Materials and Manufacture:** Glue Stock, Lining, Extraction, Washing and Clarifying, Filter Presses, Water Supply, Use of Alkalies, Action of Bacteria and of Antiseptics, Various Processes, Cleansing, Forming, Drying, Crushing, etc., Secondary Products—**Uses of Glue:** Selection and Preparation for Use, Carpentry, Veneering, Paper-Making, Bookbinding, Printing Rollers, Hectographs, Match Manufacture, Sandpaper, etc., Substitutes for other Materials, Artificial Leather and Caoutchouc—**Gelatine:** General Characters, Liquid Gelatine, Photographic Uses, Size, Tanno-, Chrome and Formo-Gelatine, Artificial Silk, Cements, Pneumatic Tyres, Culinary, Meat Extracts, Isinglass, Medicinal and other Uses, Bacteriology—**Glue Testing:** Review of Processes, Chemical Examination, Adulteration, Physical Tests, Valuation of Raw Materials—**Commercial Aspects.**

BONE PRODUCTS AND MANURES: An Account of the most recent Improvements in the Manufacture of Fat, Glue, Animal Charcoal, Size, Gelatine and Manures. By THOMAS LAMBERT, Technical and Consulting Chemist. Illustrated by Twenty-one Plans and Diagrams. 162 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Chemical Composition of Bones—Arrangement of Factory—Properties of Glue—Glutin and Chondrin—Skin Glue—Liming of Skins—Washing—Boiling of Skins—Clarification of Glue Liquors—Glue-Boiling and Clarifying-House—Specification of a Glue—Size—Uses and Pre-

paration and Composition of Size—Concentrated Size—Properties of Gelatine—Preparation of Skin Gelatine—Drying—Bone Gelatine—Selecting Bones—Crushing—Dissolving—Bleaching—Boiling—Properties of Glutin and Chondrin—Testing of Glues and Gelatines—The Uses of Glue, Gelatine and Size in Various Trades—Soluble and Liquid Glues—Steam and Waterproof Glues—**Manures**—Importation of Food Stuffs—Soils—Germination—Plant Life—**Natural Manures**—Water and Nitrogen in Farmyard Manure—Full Analysis of Farmyard Manure—Action on Crops—Water-Closet System—Sewage Manure—Green Manures—**Artificial Manures—Mineral Manures**—Nitrogenous Matters—Shoddy—Hoofs and Horns—Leather Waste—Dried Meat—Dried Blood—Superphosphates—Composition—Manufacture—Common Raw Bones—Degreased Bones—Crude Fat—Refined Fat—Degelatinised Bones—Animal Charcoal—Bone Superphosphates—Guanos—Dried Animal Products—Potash Compounds—Sulphate of Ammonia—Extraction n Vacuo—French and British Gelatines compared—Index.

Chemicals, Waste Products and Agricultural Chemistry.

REISSUE OF **CHEMICAL ESSAYS OF C. W. SCHEELE.** First Published in English in 1786. Translated from the Academy of Sciences at Stockholm, with Additions. 300 pp. Demy 8vo. Price 5s. net. (Post free, 5s. 6d. home; 5s. 9d. abroad.)

Contents.

Memoir: C. W. Scheele and his work (written for this edition by J. G. McIntosh)—On Fluor Mineral and its Acid—On Fluor Mineral—Chemical Investigation of Fluor Acid, with a View to the Earth which it Yields, by Mr. Wiegler—Additional Information Concerning Fluor Minerals—On Manganese, Magnesium, or Magnesia Vitrariorum—On Arsenic and its Acid—Remarks upon Salts of Benzoin—On Silex, Clay and Alum—Analysis of the Calculus Vesical—Method of Preparing Mercurius Dulcis Via Humida—Cheaper and more Convenient Method of Preparing Pulvis Algarothi—Experiments upon Molybdæna—Experiments on Plumbago—Method of Preparing a New Green Colour—Of the Decomposition of Neutral Salts by Unslaked Lime and Iron—On the Quantity of Pure Air which is Daily Present in our Atmosphere—On Milk and its Acid—On the Acid of Saccharum Lactis—On the Constituent Parts of Lapis Ponderosus or Tungsten—Experiments and Observations on Ether—Index.

THE MANUFACTURE OF ALUM AND THE SULPHATES AND OTHER SALTS OF ALUMINA AND IRON. Their Uses and Applications as Mordants in Dyeing and Calico Printing, and their other Applications in the Arts, Manufactures, Sanitary Engineering, Agriculture and Horticulture. Translated from the French of LUCIEN GESCHWIND. 195 Illustrations. 400 pp. Royal 8vo. Price 12s. 6d. net. (Post free, 13s. home; 13s. 6d abroad.)

Contents.

Theoretical Study of Aluminium, Iron, and Compounds of these Metals—Aluminium and its Compounds—Iron and Iron Compounds.

Manufacture of Aluminium Sulphates and Sulphates of Iron—Manufacture of Aluminium Sulphate and the Alums—Manufacture of Sulphates of Iron.

Uses of the Sulphates of Aluminium and Iron—Uses of Aluminium Sulphate and Alums—Application to Wool and Silk—Preparing and using Aluminium Acetates—Employment of Aluminium Sulphate in Carbonising Wool—The Manufacture of Lake Pigments—Manufacture of Prussian Blue—Hide and Leather Industry—Paper Making—Hardening Plaster—Lime Washes—Preparation of Non-inflammable Wood, etc.—Purification of Waste Waters—**Uses and Applications of Ferrous Sulphate and Ferric Sulphates**—Dyeing—Manufacture of Pigments—Writing Inks—Purification of Lighting Gas—Agriculture—Cotton Dyeing—Disinfectant—Purifying Waste Liquors—Manufacture of Nordhausen Sulphuric Acid—Fertilising.

Chemical Characteristics of Iron and Aluminium—Analysis of Various Aluminous or Ferruginous Products—Aluminium—**Analysing Aluminium Products**—Alunite Alumina—Sodium Aluminate—Aluminium Sulphate—**Iron**—Analytical Characteristics of Iron Salts—Analysis of Pyritic Lignite—Ferrous and Ferric Sulphates—Rouil Mordant—Index.

AMMONIA AND ITS COMPOUNDS: Their Manufacture and Uses. By CAMILLE VINCENT, Professor at the Central School of Arts and Manufactures, Paris. Translated from the French by M. J. SALTER. Royal 8vo. 114 pp. Thirty-two Illustrations. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

General Considerations: Various Sources of Ammoniacal Products; Human Urine as a Source of Ammonia—**Extraction of Ammoniacal Products from Sewage—Extraction of Ammonia from Gas Liquor—Manufacture of Ammoniacal Compounds from Bones, Nitrogenous Waste, Beetroot Wash and Peat—Manufacture of Caustic Ammonia, and Ammonium Chloride, Phosphate and Carbonate—Recovery of Ammonia from the Ammonia-Soda Mother Liquors—Index.**

INDUSTRIAL ALCOHOL. A Practical Manual on the Production and Use of Alcohol for Industrial Purposes and for Use as a Heating Agent, as an Illuminant and as a Source of Motive Power. By J. G. M'INTOSH, Lecturer on Manufacture and Applications of Industrial Alcohol at The Polytechnic, Regent Street, London. Demy 8vo. 1907. 250 pp. With 75 Illustrations and 25 Tables. Price 7s. 6d. net. (Post free, 7s. 9d. home; 8s. abroad.)

Contents.

Alcohol and its Properties.—Ethylic Alcohol—Absolute Alcohol—Adulterations—Properties of Alcohol—Fractional Distillation—Destructive Distillation—Products of Combustion—Alcoholometry—Proof Spirit—Analysis of Alcohol—Table showing Correspondence between the Specific Gravity and Per Cents. of Alcohol over and under Proof—Other Alcohol Tables. **Continuous Aseptic and Antiseptic Fermentation and Sterilisation in Industrial Alcohol Manufacture. The Manufacture of Industrial Alcohol from Beets.**—Beet Slicing Machines—Extraction of Beet Juice by Maceration, by Diffusion—Fermentation in Beet Distilleries—Plans of Modern Beet Distillery. **The Manufacture of Industrial Alcohol from Grain.**—Plan of Modern Grain Distillery. **The Manufacture of Industrial Alcohol from Potatoes. The Manufacture of Industrial Alcohol from Surplus Stocks of Wine,** Spoilt Wine, Wine Marcs, and from Fruit in General. The Manufacture of Alcohol from the Sugar Cane and Sugar Cane Molasses—Plans. **Plant, etc., for the Distillation and Rectification of Industrial Alcohol.**—The Caffey and other "Patent" Stills—Intermittent versus Continuous Rectification—Continuous Distillation—Rectification of Spent Wash. **The Manufacture and Uses of Various Alcohol Derivatives,** Ether, Haloid Ethers, Compound Ethers, Chloroform—Methyl and Amyl Alcohols and their Ethereal Salts, Acetone—Barbet's Ether, Methyl Alcohol and Acetone Rectifying Stills. **The Uses of Alcohol in Manufactures, etc.**—List of Industries in which Alcohol is used, with Key to Function of Alcohol in each Industry. **The Uses of Alcohol for Lighting, Heating, and Motive Power.**

ANALYSIS OF RESINS AND BALSAMS. Translated from the German of Dr. KARL DIETERICH. Demy 8vo. 340 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. 3d. abroad.)

MANUAL OF AGRICULTURAL CHEMISTRY. By HERBERT INGLE, F.I.C., Lecturer on Agricultural Chemistry, the Yorkshire College; Lecturer in the Victoria University. Second Edition. 388 pp. 11 Illustrations. Demy 8vo. Price 7s. 6d. net. (Post free, 8s. home; 8s. 6d. abroad.)

Contents.

Introduction—The Atmosphere—The Soil—The Reactions occurring in Soils—The Analysis of Soils—Manures, Natural—Manures (continued)—The Analysis of Manures—The Constituents of Plants—The Plant—Crops—The Animal—Foods and Feeding—Milk and Milk Products—The Analysis of Milk and Milk Products—Miscellaneous Products used in Agriculture—Appendix—Index.

THE UTILISATION OF WASTE PRODUCTS. A Treatise on the Rational Utilisation, Recovery and Treatment of Waste Products of all kinds. By Dr. THEODOR KOLLER. Translated from the Second Revised German Edition. Twenty-two Illustrations. Demy 8vo. 280 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. 3d. abroad.)

Contents.

The Waste of Towns—**Ammonia and Sal-Ammoniac**—Rational Processes for Obtaining these Substances by Treating Residues and Waste—Residues in the Manufacture of Aniline Dyes—Amber Waste—Brewers' Waste—Blood and Slaughter-House Refuse—Manufactured Fuels—Waste Paper and Bookbinders' Waste—Iron Slags—Excrement—Colouring Matters from Waste—Dyers' Waste Waters—Fat from Waste—Fish Waste—Calamine Sludge—Tannery Waste—Gold and Silver Waste—India-rubber and Caoutchouc Waste—Residues in the Manufacture of Rosin Oil—Wood Waste—Horn Waste—Infusorial Earth—Iridium from Goldsmiths' Sweepings—Jute Waste—Cork Waste—Leather Waste—Glue Makers' Waste—Illuminating Gas from Waste and the By-Products of the Manufacture of Coal Gas—Meerschum—Molasses—Metal Waste—By-Products in the Manufacture of Mineral Waters—Fruit—The By-Products of Paper and Paper Pulp Works—By-Products in the Treatment of Coal Tar Oils—Fur Waste—The Waste Matter in the Manufacture of Parchment Paper—Mother of Pearl Waste—Petroleum Residues—Platinum Residues—Broken Porcelain. Earthenware and Glass—Salt Waste—Slate Waste—Sulphur—Burnt Pyrites—Silk Waste—Soap Makers' Waste—Alkali Waste and the Recovery of Soda—Waste Produced in Grinding Mirrors—Waste Products in the Manufacture of Starch—Stearic Acid—Vegetable Ivory Waste—Turf—Waste Waters of Cloth Factories—Wine Residues—Tinplate Waste—Wool Waste—Wool Sweat—The Waste Liquids from Sugar Works—Index.

Writing Inks and Sealing Waxes.

INK MANUFACTURE: Including Writing, Copying, Lithographic, Marking, Stamping, and Laundry Inks. By SIGMUND LEHNER. Three Illustrations. Crown 8vo. 162 pp. Translated from the German of the Fifth Edition. Price 5s. net. (Post free, 5s. 3d. home; 5s. 6d. abroad.)

Contents.

Varieties of Ink—Writing Inks—Raw Materials of Tannin Inks—The Chemical Constitution of the Tannin Inks—Recipes for Tannin Inks—Logwood Tannin Inks—Ferric Inks—Alizarine Inks—Extract Inks—Logwood Inks—Copying Inks—Hektographs—Hektograph Inks—Safety Inks—Ink Extracts and Powders—Preserving Inks—Changes in Ink and the Restoration of Faded Writing—Coloured Inks—Red Inks—Blue Inks—Violet Inks—Yellow Inks—Green Inks—Metallic Inks—Indian Ink—Lithographic Inks and Pencils—Ink Pencils—Marking Inks—Ink Specialities—Sympathetic Inks—Stamping Inks—Laundry or Washing Blue—Index

SEALING-WAXES, WAFERS AND OTHER ADHESIVES FOR THE HOUSEHOLD, OFFICE, WORKSHOP AND FACTORY. By H. C. STANDAGE. Crown 8vo. 96 pp. Price 5s. net. (Post free, 5s. 3d. home; 5s. 4d. abroad.)

Contents.

Materials Used for Making Sealing-Waxes—The Manufacture of Sealing-Waxes—Wafers—Notes on the Nature of the Materials Used in Making Adhesive Compounds—Cements for Use in the Household—Office Gums, Pastes and Mucilages—Adhesive Compounds for Factory and Workshop Use.

Lead Ores and Compounds.

LEAD AND ITS COMPOUNDS. By THOS. LAMBERT, Technical and Consulting Chemist. Demy 8vo. 226 pp. Forty Illustrations. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. 3d. abroad.)

Contents.

History—Ores of Lead—Geographical Distribution of the Lead Industry—Chemical and Physical Properties of Lead—Alloys of Lead—Compounds of Lead—Dressing of Lead Ores—Smelting of Lead Ores—Smelting in the Scotch or American Ore-hearth—Smelting in the Shaft or Blast Furnace—Condensation of Lead Fume—Desilverisation, or the Separation of Silver from Argentiferous Lead—Cupellation—The Manufacture of Lead Pipes and Sheets—Protoxide of Lead—Litharge and Massicot—Red Lead or Minium—Lead Poisoning—Lead Substitutes—Zinc and its Compounds—Pumice Stone—Drying Oils and Siccatives—Oil of Turpentine Resin—Classification of Mineral Pigments—Analysis of Raw and Finished Products—Tables—Index.

NOTES ON LEAD ORES: Their Distribution and Properties. By JAS. FAIRIE, F.G.S. Crown 8vo. 64 pages. Price 2s. 6d. net. (Post free, 2s. 9d. home; 3s. abroad.)

(*White Lead and Zinc White Paints, see p.* 4.)

Industrial Hygiene.

THE RISKS AND DANGERS TO HEALTH OF VARIOUS OCCUPATIONS AND THEIR PREVENTION. By LEONARD A. PARRY, M.D., B.Sc. (Lond.). 196 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Occupations which are Accompanied by the Generation and Scattering of Abnormal Quantities of Dust—Trades in which there is Danger of Metallic Poisoning—Certain Chemical Trades—Some Miscellaneous Occupations—Trades in which Various Poisonous Vapours are Inhaled—General Hygienic Considerations—Index.

Industrial Uses of Air, Steam and Water.

DRYING BY MEANS OF AIR AND STEAM. Explanations, Formulæ, and Tables for Use in Practice. Translated from the German of E. HAUSBRAND. Two folding Diagrams and Thirteen Tables. Crown 8vo. 72 pp. Price 5s. net. (Post free, 5s. 3d. home; 5s. 6d. abroad.)

Contents.

British and Metric Systems Compared—Centigrade and Fahr. Thermometers—Estimation of the Maximum Weight of Saturated Aqueous Vapour which can be contained in 1 kilo. of Air at Different Pressure and Temperatures—Calculation of the Necessary Weight and Volume of Air, and of the Least Expenditure of Heat, per Drying Apparatus with Heated Air, at the Atmospheric Pressure: *A*, With the Assumption that the Air is *Completely Saturated* with Vapour both before Entry and after Exit from the Apparatus—*B*, When the Atmospheric Air is Completely Saturated *before entry*, but at its *exit* is *only* $\frac{3}{4}$, $\frac{1}{2}$ or $\frac{1}{4}$ Saturated—*C*, When the Atmospheric Air is *not* Saturated with Moisture before Entering the Drying Apparatus—Drying Apparatus, in which, in the Drying Chamber, a Pressure is Artificially Created, Higher or Lower than that of the Atmosphere—Drying by Means of Superheated Steam, without Air—Heating Surface, Velocity of the Air Current, Dimensions of the Drying Room, Surface of the Drying Material, Losses of Heat—Index.

(*See also "Evaporating, Condensing and Cooling Apparatus," p.* 26.)

PURE AIR, OZONE AND WATER. A Practical Treatise of their Utilisation and Value in Oil, Grease, Soap, Paint, Glue and other Industries. By W. B. COWELL. Twelve Illustrations. Crown 8vo. 85 pp. Price 5s. net. (Post free, 5s. 3d. home; 5s. 6d. abroad.)

Contents.

Atmospheric Air; Lifting of Liquids; Suction Process; Preparing Blown Oils; Preparing Siccative Drying Oils—Compressed Air; Whitewash—Liquid Air; Retrocession—Purification of Water; Water Hardness—Fleshings and Bones—Ozonised Air in the Bleaching and Deodorising of Fats, Glues, etc.; Bleaching Textile Fibres—Appendix: Air and Gases; Pressure of Air at Various Temperatures; Fuel; Table of Combustibles; Saving of Fuel by Heating Feed Water; Table of Solubilities of Scale Making Minerals; British Thermal Units Tables; Volume of the Flow of Steam into the Atmosphere; Temperature of Steam—Index.

THE INDUSTRIAL USES OF WATER. COMPOSITION — EFFECTS—TROUBLES — REMEDIES—RESIDUARY WATERS—PURIFICATION—ANALYSIS. By H. DE LA COUX. Royal 8vo. Translated from the French and Revised by ARTHUR MORRIS. 364 pp. 135 Illustrations. Price 10s. 6d. net. (Post free, 11s. home; 11s. 6d. abroad.)

Contents.

Chemical Action of Water in Nature and in Industrial Use—Composition of Waters—Solubility of Certain Salts in Water Considered from the Industrial Point of View—Effects on the Boiling of Water—Effects of Water in the Industries—Difficulties with Water—Feed Water for Boilers—Water in Dyeworks, Print Works, and Bleach Works—Water in the Textile Industries and in Conditioning—Water in Soap Works—Water in Laundries and Washhouses—Water in Tanning—Water in Preparing Tannin and Dyewood Extracts—Water in Papermaking—Water in Photography—Water in Sugar Refining—Water in Making Ices and Beverages—Water in Cider Making—Water in Brewing—Water in Distilling—Preliminary Treatment and Apparatus—Substances Used for Preliminary Chemical Purification—Commercial Specialities and their Employment—Precipitation of Matters in Suspension in Water—Apparatus for the Preliminary Chemical Purification of Water—Industrial Filters—Industrial Sterilisation of Water—Residuary Waters and their Purification—Soil Filtration—Purification by Chemical Processes—Analyses—Index.

(*See Books on Smoke Prevention, Engineering and Metallurgy, p.* 26, *etc.*)

X Rays.

PRACTICAL X RAY WORK. By FRANK T. ADDYMAN, B.Sc. (Lond.), F.I.C., Member of the Roentgen Society of London; Radiographer to St. George's Hospital; Demonstrator of Physics and Chemistry, and Teacher of Radiography in St. George's Hospital Medical School. Demy 8vo. Twelve Plates from Photographs of X Ray Work. Fifty-two Illustrations. 200 pp. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. 3d. abroad.)

Contents.

Historical—Work leading up to the Discovery of the X Rays—The Discovery—**Apparatus and its Management**—Electrical Terms—Sources of Electricity—Induction Coils—Electrostatic Machines—Tubes—Air Pumps—Tube Holders and Stereoscopic Apparatus—Fluorescent Screens—**Practical X Ray Work**—Installations—Radioscopy—Radiography—X Rays in Dentistry—X Rays in Chemistry—X Rays in War—Index.

List of Plates.

Frontispiece—Congenital Dislocation of Hip-Joint.—I., Needle in Finger.—II., Needle in Foot.—III., Revolver Bullet in Calf and Leg.—IV., A Method of Localisation.—V., Stellate Fracture of Patella showing shadow of "Strapping".—VI., Sarcoma.—VII., Six-weeks-old Injury to Elbow showing new Growth of Bone.—VIII., Old Fracture of Tibia and Fibula badly set.—IX., Heart Shadow.—X., Fractured Femur showing Grain of Splint.—XI., Barrell's Method of Localisation.

India-Rubber and Gutta Percha.

INDIA-RUBBER AND GUTTA PERCHA. Translated from the French of T. SEELIGMANN, G. LAMY TORVILHON and H. FALCONNET by JOHN GEDDES McINTOSH. Royal 8vo.

[*Out of print. Second Edition in preparation.*

Contents.

India-Rubber—Botanical Origin—Climatology—Soil—Rational Culture and Acclimation of the Different Species of India-Rubber Plants—Methods of Obtaining the Latex—Methods of Preparing Raw or Crude India-Rubber—Classification of the Commercial Species of Raw Rubber—Physical and Chemical Properties of the Latex and of India-Rubber—Mechanical Transformation of Natural Caoutchouc into Washed or Normal Caoutchouc (Purification) and Normal Rubber into Masticated Rubber—Softening, Cutting, Washing, Drying—Preliminary Observations—Vulcanisation of Normal Rubber—Chemical and Physical Properties of Vulcanised Rubber—General Considerations—Hardened Rubber or Ebonite—Considerations on Mineralisation and other Mixtures—Coloration and Dyeing—Analysis of Natural or Normal Rubber and Vulcanised Rubber—Rubber Substitutes—Imitation Rubber.

Gutta Percha—Botanical Origin—Climatology—Soil—Rational Culture—Methods of Collection—Classification of the Different Species of Commercial Gutta Percha—Physical and Chemical Properties—Mechanical Transformation—Methods of Analysing—Gutta Percha Substitutes—Index.

Leather Trades.

PRACTICAL TREATISE ON THE LEATHER INDUSTRY. By A. M. VILLON. Translated by FRANK T. ADDYMAN, B.Sc. (Lond.), F.I.C., F.C.S.; and Corrected by an Eminent Member of the Trade. 500 pp., royal 8vo. 123 Illustrations. Price 21s. net. (Post free, 21s. 6d. home; 22s. 6d. abroad.)

Contents.

Preface—Translator's Preface—List of Illustrations.

Part I., **Materials used in Tanning**—Skins: Skin and its Structure; Skins used in Tanning; Various Skins and their Uses—Tannin and Tanning Substances: Tannin; Barks (Oak); Barks other than Oak; Tanning Woods; Tannin-bearing Leaves; Excrescences; Tan-bearing Fruits; Tan-bearing Roots and Bulbs; Tanning Juices; Tanning Substances used in Various Countries; Tannin Extracts; Estimation of Tannin and Tannin Principles.

Part II., **Tanning**—The Installation of a Tannery: Tan Furnaces; Chimneys, Boilers, etc.; Steam Engines—Grinding and Trituration of Tanning Substances: Cutting up Bark; Grinding Bark; The Grinding of Tan Woods; Powdering Fruit, Galls and Grains; Notes on the Grinding of Bark—Manufacture of Sole Leather: Soaking; Sweating and Unhairing; Plumping and Colouring; Handling; Tanning; Tanning Elephants' Hides; Drying; Striking or Pinning—Manufacture of Dressing Leather: Soaking; Depilation; New Processes for the Depilation of Skins; Tanning; Cow Hides; Horse Hides; Goat Skins; Manufacture of Split Hides—On Various Methods of Tanning: Mechanical Methods; Physical Methods; Chemical Methods; Tanning with Extracts—Quantity and Quality; Quantity; Net Cost; Quality of Leather—Various Manipulations of Tanned Leather: Second Tanning; Grease Stains; Bleaching Leather; Waterproofing Leather; Weighting Tanned Leather; Preservation of Leather—Tanning Various Skins.

Part III., **Currying** — Waxed Calf: Preparation; Shaving; Stretching or Slicking; Oiling the Grain; Oiling the Flesh Side; Whitening and Graining; Waxing; Finishing; Dry Finishing; Finishing in Colour; Cost — White Calf: Finishing in White—Cow Hide for Upper Leathers: Black Cow Hide; White Cow Hide; Coloured Cow Hide—Smooth Cow Hide—Black Leather—Miscellaneous Hides: Horse; Goat; Waxed Goat Skin; Matt Goat Skin—Russia Leather: Russia Leather; Artificial Russia Leather.

Part IV., **Enamelled, Hungary and Chamoy Leather, Morocco, Parchment, Furs and Artificial Leather**—Enamelled Leather: Varnish Manufacture; Application of the Enamel; Enamelling in Colour—Hungary Leather: Preliminary; Wet Work or Preparation; Aluming; Dressing or Loft Work; Tallowing; Hungary Leather from Various Hides—Tawing: Preparatory Operations; Dressing; Dyeing Tawed Skins; Rugs—Chamoy Leather—Morocco: Preliminary Operations, Morocco Tanning; Mordants used in Morocco Manufacture; Natural Colours used in Morocco Dyeing; Artificial Colours; Different Methods of Dyeing; Dyeing with Natural Colours; Dyeing with Aniline Colours; Dyeing with Metallic Salts; Leather Printing; Finishing Morocco; Shagreen; Bronzed Leather—Gilding and Silvering: Gilding; Silvering; Nickel and Cobalt—Parchment—Furs and Furriery: Preliminary Remarks; Indigenous Furs; Foreign Furs from Hot Countries; Foreign Furs from Cold Countries; Furs from Birds' Skins; Preparation of Furs; Dressing; Colouring; Preparation of Birds' Skins; Preservation of Furs—Artificial Leather: Leather made from Scraps; Compressed Leather; American Cloth; Pàpier Mâché; Linoleum; Artificial Leather.

Part V., **Leather Testing and the Theory of Tanning**—Testing and Analysis of Leather: Physical Testing of Tanned Leather; Chemical Analysis—The Theory of Tanning and the other Operations of the Leather and Skin Industry: Theory of Soaking; Theory of Unhairing; Theory of Swelling; Theory of Handling; Theory of Tanning; Theory of the Action of Tannin on the Skin; Theory of Hungary Leather Making; Theory of Tawing; Theory of Chamoy Leather Making; Theory of Mineral Tanning.

Part VI., **Uses of Leather**—Machine Belts: Manufacture of Belting; Leather Chain Belts; Various Belts; Use of Belts—Boot and Shoe-making: Boots and Shoes; Laces—Saddlery: Composition of a Saddle; Construction of a Saddle—Harness: The Pack Saddle; Harness—Military Equipment—Glove Making—Carriage Building—Mechanical Uses.

Appendix, **The World's Commerce in Leather**—Europe; America; Asia; Africa; Australasia—Index.

THE LEATHER WORKER'S MANUAL. Being a Compendium of Practical Recipes and Working Formulæ for Curriers, Bootmakers, Leather Dressers, Blacking Manufacturers, Saddlers, Fancy Leather Workers. By H. C. STANDAGE. Demy 8vo. 165 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Blackings, Polishes, Glosses, Dressings, Renovators, etc., for Boot and Shoe Leather—Harness Blackings, Dressings, Greases, Compositions, Soaps, and Boot-top Powders and Liquids, etc., etc.—Leather Grinders' Sundries—Currier's Seasonings, Blacking Compounds, Dressings, Finishes, Glosses, etc.—Dyes and Stains for Leather—Miscellaneous Information—Chrome Tannage—Index.

Books on Pottery, Bricks, Tiles, Glass, etc.

THE MANUAL OF PRACTICAL POTTING. Compiled by Experts, and Edited by CHAS. F. BINNS. Third Edition, Revised and Enlarged. 200 pp. Demy 8vo. Price 17s. 6d. net. (Post free, 17s. 10d. home; 18s. 3d. abroad.)

Contents.

Introduction. The Rise and Progress of the Potter's Art—**Bodies.** China and Porcelain Bodies, Parian Bodies, Semi-porcelain and Vitreous Bodies, Mortar Bodies, Earthenwares Granite and C.C. Bodies, Miscellaneous Bodies, Sagger and Crucible Clays, Coloured Bodies, Jasper Bodies, Coloured Bodies for Mosaic Painting, Encaustic Tile Bodies, Body Stains, Coloured Dips—**Glazes.** China Glazes, Ironstone Glazes, Earthenware Glazes, Glazes without Lead, Miscellaneous Glazes, Coloured Glazes, Majolica Colours—**Gold and Gold Colours.** Gold, Purple of Cassius, Marone and Ruby, Enamel Coloured Bases, Enamel Colour Fluxes, Enamel Colours, Mixed Enamel Colours, Antique and Vellum Enamel Colours, Underglaze Colours, Underglaze Colour Fluxes, Mixed Underglaze Colours, Flow Powders, Oils and Varnishes—**Means and Methods.** Reclamation of Waste Gold, The Use of Cobalt, Notes on Enamel Colours, Liquid or Bright Gold—**Classification and Analysis.** Classification of Clay Ware, Lord Playfair's Analysis of Clays, The Markets of the World, Time and Scale of Firing, Weights of Potter's Material, Decorated Goods Count—Comparative Loss of Weight of Clays—Ground Felspar Calculations—The Conversion of Slop Body Recipes into Dry Weight—The Cost of Prepared Earthenware Clay—**Forms and Tables.** Articles of Apprenticeship, Manufacturer's Guide to Stocktaking, Table of Relative Values of Potter's Materials, Hourly Wages Table, Workman's Settling Table, Comparative Guide for Earthenware and China Manufacturers in the use of Slop Flint and Slop Stone, Foreign Terms applied to Earthenware and China Goods, Table for the Conversion of Metrical Weights and Measures on the Continent and South America—**Index.**

CERAMIC TECHNOLOGY: Being some Aspects of Technical Science as Applied to Pottery Manufacture. Edited by CHARLES F. BINNS. 100 pp. Demy 8vo. Price 12s. 6d. net. (Post free, 12s. 10d. home; 13s. abroad.)

Contents.

Preface—The Chemistry of Pottery — Analysis and Synthesis — Clays and their Components — The Biscuit Oven — Pyrometry — Glazes and their Composition — Colours and Colour-making—Index.

A TREATISE ON THE CERAMIC INDUSTRIES. A Complete Manual for Pottery, Tile and Brick Works. By EMILE BOURRY. Translated from the French by WILTON P. RIX, Examiner in Pottery and Porcelain to the City and Guilds of London Technical Institute, Pottery Instructor to the Hanley School Board. Royal 8vo. 760 pp. 323 Illustrations. Price 21s. net. (Post free, 22s. home; 24s. abroad.)

Contents.

Part I., **General Pottery Methods.** Definition and History. Definitions and Classification of Ceramic Products—Historic Summary of the Ceramic Art—Raw Materials of Bodies. Clays: Pure Clay and Natural Clays—Various Raw Materials: Analogous to Clay—Agglomerative and Agglutinative—Opening—Fusible—Refractory—Trials of Raw Materials—Plastic Bodies. Properties and Composition—Preparation of Raw Materials: Disaggregation—Purification—Preparation of Bodies: By Plastic Method—By Dry Method—By Liquid Method—Formation. Processes of Formation: Throwing—Expression—Moulding by Hand on the Jolley, by Compression, by Slip Casting—Slapping—Slipping—Drying. Drying of Bodies—Processes of Drying: By Evaporation—By Aeration—By Heating—By Ventilation—By Absorption — Glazes. Composition and Properties—Raw Materials — Manufacture and Application—Firing. Properties of the Bodies and Glazes during Firing—Description of the Kilns—Working of the Kilns — Decoration. Colouring Materials — Processes of Decoration.

Part II., **Special Pottery Methods.** Terra Cottas. Classification: Plain Ordinary, Hollow, Ornamental, Vitrified, and Light Bricks—Ordinary and Black Tiles—Paving Tiles—Pipes—Architectural Terra Cottas—Vases, Statues and Decorative Objects—Common Pottery—Pottery for Water and Filters—Tobacco Pipes—Lustre Ware—Properties and Tests for Terra Cottas — Fireclay Goods. Classification: Argillaceous, Aluminous, Carboniferous, Silicious and Basic Fireclay Goods—Fireclay Mortar (Pug)—Tests for Fireclay Goods—Faiences. Varnished Faiences—Enamelled Faiences—Silicious Faiences—Pipeclay Faiences—Pebble Work—Feldspathic Faiences—Composition, Processes of Manufacture and General Arrangements of Faience Potteries—Stoneware. Stoneware Properly So-called: Paving Tiles—Pipes—Sanitary Ware—Stoneware for Food Purposes and Chemical Productions—Architectural Stoneware—Vases, Statues and other Decorative Objects—Fine Stoneware—Porcelain. Hard Porcelain for Table Ware and Decoration, for the Fire, for Electrical Conduits, for Mechanical Purposes; Architectural Porcelain, and Dull or Biscuit Porcelain—Soft Phosphated or English Porcelain—Soft Vitreous Porcelain, French and New Sèvres—Argillaceous Soft or Seger's Porcelain—Dull Soft or Parian Porcelain—Dull Feldspathic Soft Porcelain—**Index.**

POTTERY DECORATING. A Description of all the Processes for Decorating Pottery and Porcelain. By R. HAINBACH. Translated from the German. Crown 8vo. 250 pp. Twenty-two Illustrations. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Glazes and Engobes.—Glazes and Their Composition—Glaze Materials—The Preparation of Glazes—Coloured Glazes—Engobes and Glazes for same—Porcelain Glazes. **Ceramic Colours.**—Preparation of Pure Colours—Underglaze Colours—Applying the Colours on Earthenware—Glost Fire Colours—Muffle Colours—Decorating Porcelain with Metals—Decorating Porcelain by Electroplating—Lustre Decorating on Porcelain—Firing Muffle Colours—Imitation of Paintings on Porcelain—Index.

ARCHITECTURAL POTTERY. Bricks, Tiles, Pipes, Enamelled Terra-cottas, Ordinary and Incrusted Quarries, Stoneware Mosaics, Faïences and Architectural Stoneware. By LEON LEFÊVRE. Translated from the French by K. H. BIRD, M.A., and W. MOORE BINNS. With Five Plates. 950 Illustrations in the Text, and numerous estimates. 500 pp., royal 8vo. Price 15s. net. (Post free, 15s. 6d. home; 16s. 6d. abroad.)

Contents.

Part I. **Plain Undecorated Pottery.—Clays, Bricks, Tiles, Pipes, Chimney Flues, Terra-cotta.**

Part II. **Made-up or Decorated Pottery.**

THE ART OF RIVETING GLASS, CHINA AND EARTHENWARE. By J. HOWARTH. Second Edition. Paper Cover. Price 1s. net. (By post, home or abroad, 1s. 1d.)

NOTES ON POTTERY CLAYS. The Distribution, Properties, Uses and Analyses of Ball Clays, China Clays and China Stone. By JAS. FAIRIE, F.G.S. 132 pp. Crown 8vo. Price 3s. 6d. net. (Post free, 3s. 9d. home; 3s. 10d. abroad.)

A Reissue of

THE HISTORY OF THE STAFFORDSHIRE POTTERIES; AND THE RISE AND PROGRESS OF THE MANUFACTURE OF POTTERY AND PORCELAIN. With References to Genuine Specimens, and Notices of Eminent Potters. By SIMEON SHAW. (Originally Published in 1829.) 265 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. 3d. abroad.)

Contents.

Introductory Chapter showing the position of the Pottery Trade at the present time (1899)—**Preliminary Remarks**—**The Potteries**, comprising Tunstall, Brownhills, Greenfield and New Field, Golden Hill, Latebrook, Green Lane, Burslem, Longport and Dale Hall, Hot Lane and Cobridge, Hanley and Shelton, Etruria, Stoke, Penkhull, Fenton, Lane Delph, Foley, Lane End—**On the Origin of the Art**, and its Practice among the early Nations—**Manufacture of Pottery**, prior to 1700—**The Introduction of Red Porcelain** by Messrs. Elers, of Bradwell, 1690—**Progress of the Manufacture** from 1700 to Mr. Wedgwood's commencement in 1760—**Introduction of Fluid Glaze**—Extension of the Manufacture of Cream Colour—Mr. Wedgwood's Queen's Ware—Jasper, and Appointment of Potter to Her Majesty—Black Printing—**Introduction of Porcelain.** Mr. W. Littler's Porcelain—Mr. Cookworthy's Discovery of Kaolin and Petuntse, and Patent—Sold to Mr. Champion—resold to the New Hall Com.—Extension of Term—**Blue Printed Pottery.** Mr. Turner, Mr. Spode (1), Mr. Baddeley, Mr. Spode (2), Messrs. Turner, Mr. Wood, Mr. Wilson, Mr. Minton—Great Change in Patterns of Blue Printed—**Introduction of Lustre Pottery.** Improvements in Pottery and Porcelain subsequent to 1800.

A Reissue of

THE CHEMISTRY OF THE SEVERAL NATURAL AND ARTIFICIAL HETEROGENEOUS COMPOUNDS USED IN MANUFACTURING PORCELAIN, GLASS AND POTTERY. By SIMEON SHAW. (Originally published in 1837.) 750 pp. Royal 8vo. Price 14s. net. (Post free, 15s. home; 17s. abroad.)

Glassware, Glass Staining and Painting.

RECIPES FOR FLINT GLASS MAKING. By a British Glass Master and Mixer. Sixty Recipes. Being Leaves from the Mixing Book of several experts in the Flint Glass Trade, containing up-to-date recipes and valuable information as to Crystal, Demi-crystal and Coloured Glass in its many varieties. It contains the recipes for cheap metal suited to pressing, blowing, etc., as well as the most costly crystal and ruby. Second Edition. Crown 8vo. Price 10s. 6d. net. (Post free, 10s. 9d. home; 10s. 10d. abroad.)

Contents.

Ruby—Ruby from Copper—Flint for using with the Ruby for Coating—A German Metal—ornelian, or Alabaster—Sapphire Blue—Crysophis—Opal—Turquoise Blue—Gold Colour—Dark Green—Green (common)—Green for Malachite—Blue for Malachite—Black for Melachite—Black—Common Canary Batch—Canary—White Opaque Glass—Sealing-wax Red—Flint—Flint Glass (Crystal and Demi)—Achromatic Glass—Paste Glass—White Enamel—Firestone—Dead White (for moons)—White Agate—Canary—Canary Enamel—Index.

A TREATISE ON THE ART OF GLASS PAINTING. Prefaced with a Review of Ancient Glass. By ERNEST R. SUFFLING. With One Coloured Plate and Thirty-seven Illustrations. Demy 8vo. 140 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home ; 8s. abroad.)

Contents.

A Short History of Stained Glass—Designing Scale Drawings—Cartoons and the Cut Line—Various Kinds of Glass Cutting for Windows—The Colours and Brushes used in Glass Painting—Painting on Glass, Dispersed Patterns—Diapered Patterns—Aciding—Firing—Fret Lead Glazing—Index.

PAINTING ON GLASS AND PORCELAIN AND ENAMEL PAINTING. A Complete Introduction to the Preparation of all the Colours and Fluxes used for Painting on Porcelain, Enamel, Faïence and Stoneware, the Coloured Pastes and Coloured Glasses, together with a Minute Description of the Firing of Colours and Enamels. By FELIX HERMANN, Technical Chemist. With Eighteen Illustrations. 300 pp. Translated from the German second and enlarged Edition. Price 10s. 6d. net. (Post free, 10s. 10d. home ; 11s. abroad.)

Paper Making, Paper Dyeing, and Testing.

THE DYEING OF PAPER PULP. A Practical Treatise for the use of Papermakers, Paperstainers, Students and others. By JULIUS ERFURT, Manager of a Paper Mill. Translated into English and Edited with Additions by JULIUS HÜBNER, F.C.S., Lecturer on Papermaking at the Manchester Municipal Technical School. With Illustrations and **157 patterns of paper dyed in the pulp.** Royal 8vo, 180 pp. Price 15s. net. (Post free, 15s. 6d. home ; 16s. 6d. abroad.)

Contents.

Behaviour of the Paper Fibres during the Process of Dyeing, Theory of the Mordant—Colour Fixing Mediums (Mordants)—Influence of the Quality of the Water Used—Inorganic Colours—Organic Colours—Practical Application of the Coal Tar Colours according to their Properties and their Behaviour towards the Different Paper Fibres—Dyed Patterns on Various Pulp Mixtures—Dyeing to Shade—Index.

THE PAPER MILL CHEMIST. By HENRY P. STEVENS, M.A., Ph.D., F.I.C. Royal 12mo. 60 Illustrations. 300 pp. Price 7s. 6d. net. (Post free, 7s. 9d. home ; 7s. 10d. abroad.)

Contents.

Introduction.—Dealing with the Apparatus required in Chemical Work and General Chemical Manipulation, introducing the subject of Qualitative and Quantitative Analysis. **Fuels.**—Analysis of Coal, Coke and other Fuels—Sampling and Testing for Moisture, Ash, Calorific Value, etc.—Comparative Heating Value of different Fuels and Relative Efficiency. **Water.**—Analysis for Steam Raising and for Paper Making Purposes generally—Water Softening and Purification—A List of the more important Water Softening Plant, giving Power required, Weight, Space Occupied, Out-put and Approximate Cost. **Raw Materials and Detection of Adulterants.**—Analysis and Valuation of the more important Chemicals used in Paper Making, including Lime, Caustic Soda, Sodium Carbonate, Mineral Acids, Bleach Antichlor, Alum, Rosin and Rosin Size, Glue Gelatin and Casein, Starch, China Clay, Blanc Fixe, Satin White and other Loading Materials, Mineral Colours and Aniline Dyes. **Manufacturing Operations.**—Rags and the Chemical Control of Rag Boiling—Esparto Boiling—Wood Boiling—Testing Spent Liquors and Recovered Ash—Experimental Tests with Raw Fibrous Materials—Boiling in Autoclaves—Bleaching and making up Hand Sheets—Examination of Sulphite Liquors—Estimation of Moisture in Pulp and Half-stuff—Recommendations of the British Wood Pulp Association. **Finished Products.**—Paper Testing, including Physical, Chemical and Microscopical Tests, Area, Weight, Thickness, Apparent Specific Gravity, Bulk or Air Space. Determination of Machine Direction, Thickness, Strength, Stretch, Resistance to Crumpling and Friction, Transparency, Absorbency and other qualities of Blotting Papers—Determination of the Permeability of Filtering Papers—Detection and Estimation of Animal and Vegetable Size in Paper—Sizing Qualities of Paper—Fibrous Constituents—Microscopical Examination of Fibres—The Effect of Beating on Fibres—Staining Fibres—Mineral Matter—Ash—Qualitative and Quantitative Examination of Mineral Matter—Examination of Coated Papers and Colouring Matters in Paper.

CONTENTS OF "THE PAPER MILL CHEMIST"—*contd.*

Tables.—English and Metrical Weights and Measures with Equivalents—Conversion of Grams to Grains and *vice versâ*—Equivalent Costs per lb., cwt., and ton—Decimal Equivalents of lbs., qrs., and cwts.—Thermometric and Barometric Scales—Atomic Weights and Molecular Weights—Factors for Calculating the Percentage of Substance Sought from the Weight of Substance Found—Table of Solubilities of Substances Treated of in Paper Making—Specific Gravity Tables of such substances as are used in Paper Making, including Sulphuric Acid, Hydrochloric Acid, Bleach, Milk of Lime, Caustic Soda, Carbonate of Soda, etc., giving Percentage Strength with Specific Gravity and Degrees Tw.—Hardness Table for Soap Tests—Dew Point—Wet and Dry Bulb Tables—Properties of Saturated Steam, giving Temperature, Pressure and Volume—List of Different Machines used in the Paper Making Industry, giving Size, Weight, Space Occupied, Power to Drive, Out-put and Approximate Cost—Calculation of Moisture in Pulp—Rag-Boiling Tables, giving Percentages of Lime, Soda and Time required—Loss in Weight in Rags and other Raw Materials during Boiling and Bleaching—Conditions of Buying and Selling as laid down by the Paper Makers' Association—Table of Names and Sizes of Papers—Table for ascertaining the Weight per Ream from the Weight per Sheet—Calculations of Areas and Volumes—Logarithms—Blank pages for Notes.

THE TREATMENT OF PAPER FOR SPECIAL PURPOSES. By L. E. Andés. Translated from the German. Crown 8vo. 48 Illustrations. 250 pp. Price 6s. net. (Post free, 6s. 4d. home; 6s. 6d. abroad).

Contents.

I., **Parchment Paper, Vegetable Parchment.**—The Parchment Paper Machine—Opaque Supple Parchment Paper—Thick Parchment—Krugler's Parchment Paper and Parchment Slates—Double and Triple Osmotic Parchment—Utilising Waste Parchment Paper—Parchmented Linen and Cotton—Parchment Millboard—Imitation Horn and Ivory from Parchment Paper—Imitation Parchment Paper—Artificial Parchment—Testing the Sulphuric Acid. II., Papers for Transfer Pictures. **III., Papers for Preservative and Packing Purposes.**—Butter Paper—Wax Paper—Paraffin Paper—Wrapping Paper for Silverware—Waterproof Paper—Anticorrosive Paper. IV., Grained Transfer Papers. V., Fireproof and Antifalsification Papers. **VI., Paper Articles.**—Vulcanised Paper Maché—Paper Bottles—Plastic Articles of Paper—Waterproof Coverings for Walls and Ceilings—Paper Wheels, Roofing and Boats—Paper Barrels—Paper Boxes—Paper Horseshoes. VII., Gummed Paper. VIII., Hectograph Papers. **IX., Insecticide Papers.**—Fly Papers—Moth Papers. **X., Chalk and Leather Papers.**—Glacé Chalk Paper—Leather Paper—Imitation Leather. XI., Luminous Papers—Blue-Print Papers—Blotting Papers. XII., Metal Papers—Medicated Papers. XIII., Marbled Papers. XIV., Tracing and Copying Papers—Iridiscent or Mother of Pearl Papers. XV., Photographic Papers—Shellac Paper—Fumigating Papers—Test Papers. **XVI., Papers for Cleaning and Polishing Purposes—Glass Paper**—Pumic Paper—Emery Paper. XVII., Lithographic Transfer Papers. **XIX., Sundry Special Papers**—Satin Paper—Enamel Paper—Cork Paper—Split Paper—Electric Paper—Paper Matches—Magic Pictures—Laundry Blue Papers—Blue Paper for Bleachers. XX., Waterproof Papers—Washable Drawing Papers—Washable Card—Washable Coloured Paper—Waterproof Millboard—Sugar Paper. XXI., The Characteristics of Paper—Paper Testing.

Enamelling on Metal.

ENAMELS AND ENAMELLING. For Enamel Makers, Workers in Gold and Silver, and Manufacturers of Objects of Art. By Paul Randau. Translated from the German. With Sixteen Illustrations. Demy 8vo. 180 pp. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. abroad.)

THE ART OF ENAMELLING ON METAL. By W. Norman Brown. Twenty-eight Illustrations. Crown 8vo. 60 pp. Price 2s. 6d. net. (Post free, 2s. 9d. home and abroad.)

Silk Manufacture.

SILK THROWING AND WASTE SILK SPINNING. By Hollins Rayner. Demy 8vo. 170 pp. 117 Illus. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

The Silkworm—Cocoon Reeling and Qualities of Silk—Silk Throwing—Silk Wastes—The Preparation of Silk Waste for Degumming—Silk Waste Degumming, Schapping and Discharging—The Opening and Dressing of Wastes—Silk Waste "Drawing" or "Preparing" Machinery—Long Spinning—Short Spinning—Spinning and Finishing Processes—Utilisation of Waste Products—Noil Spinning—Exhaust Noil Spinning.

Books on Textile and Dyeing Subjects.

THE CHEMICAL TECHNOLOGY OF TEXTILE FIBRES: Their Origin, Structure, Preparation, Washing, Bleaching, Dyeing, Printing and Dressing. By Dr. GEORG VON GEORGIEVICS. Translated from the German by CHARLES SALTER. 320 pp. Forty-seven Illustrations. Royal 8vo. Price 10s. 6d. net. (Post free, 11s. home; 11s. 3d. abroad.)

Contents.

The Textile Fibres—Washing, Bleaching, Carbonising—Mordants and Mordanting—Dyeing—Printing—Dressing and Finishing.

POWER-LOOM WEAVING AND YARN NUMBERING, According to Various Systems, with Conversion Tables. Translated from the German of ANTHON GRUNER. **With Twenty-six Diagrams in Colours.** 150 pp. Crown 8vo. Price 7s. 6d. net. (Post free, 7s. 9d. home; 8s. abroad.)

Contents.

Power-Loom Weaving in General. Various Systems of Looms—**Mounting and Starting the Power-Loom.** English Looms—Tappet or Treadle Looms—Dobbies—**General Remarks on the Numbering, Reeling and Packing of Yarn—Appendix—Useful Hints.** Calculating Warps—Weft Calculations—Calculations of Cost Price in Hanks.

TEXTILE RAW MATERIALS AND THEIR CONVERSION INTO YARNS. (The Study of the Raw Materials and the Technology of the Spinning Process.) By JULIUS ZIPSER. Translated from German by CHARLES SALTER. 302 Illustrations. 500 pp. Demy 8vo. Price 10s. 6d. net. (Post free, 11s. home; 11s. 6d. abroad.)

Contents.

PART I.—The Raw Materials Used in the Textile Industry.

MINERAL RAW MATERIALS. VEGETABLE RAW MATERIALS. ANIMAL RAW MATERIALS.

PART II.—The Technology of Spinning or the Conversion of Textile Raw Materials into Yarn.

SPINNING VEGETABLE RAW MATERIALS. Cotton Spinning—Installation of a Cotton Mill—Spinning Waste Cotton and Waste Cotton Yarns—Flax Spinning—Fine Spinning—Tow Spinning—Hemp Spinning—Spinning Hemp Tow String—Jute Spinning—Spinning Jute Line Yarn—Utilising Jute Waste.

PART III.—Spinning Animal Raw Materials.

Spinning Carded Woollen Yarn—Finishing Yarn—Worsted Spinning—Finishing Worsted Yarn—Artificial Wool or Shoddy Spinning—Shoddy and Mungo Manufacture—Spinning Shoddy and other Wool Substitutes—Spinning Waste Silk—Chappe Silk—Fine Spinning—Index.

GRAMMAR OF TEXTILE DESIGN. By H. NISBET, Weaving and Designing Master, Bolton Municipal Technical School. Demy 8vo. 280 pp. 490 Illustrations and Diagrams. Price 6s. net. (Post free, 6s. 4d. home; 6s. 6d. abroad.)

Contents.

Chapter I., INTRODUCTION.—General Principle of Fabric Structure and the use of Design Paper.

Chapter II., THE PLAIN WEAVE AND ITS MODIFICATIONS.—**The Plain, Calico, or Tabby Weave.**—Firmness of Texture—Variety of Texture—Variety of Form: Ribbed Fabrics—Corded Fabrics—Matt Weaves.

Chapter III., TWILL AND KINDRED WEAVES.—Classification of Twill Weaves.—**1. Continuous Twills**—(*a*) *Warp-face Twills*—(*b*) *Weft-face Twills*—(*c*) *Warp and Weft-face Twills*—The Angle of Twill—Influences affecting the Prominence of Twills and Kindred Weaves (*a*) *Character of Weave,* (*b*) *Character of Yarn,* (*c*) *Number of Threads per Inch,* (*d*) *Direction of Twill in Relation to the Direction of Twist in Yarn*—**2. Zigzag or Wavy Twills—3. Rearranged Twills:** Satin Weaves—Table of Intervals of Selection for the Construction of Satin Weaves—Corkscrew Twills—Rearrangement of Twill Weaves on Satin and other Bases—**4. Combined Twills—5. Broken Twills—6. Figured or Ornamented Twills.**

Chapter IV., DIAMOND AND KINDRED WEAVES,—**Diamond Weaves.**—Honeycomb and Kindred Weaves—Brighton Weaves—Sponge Weaves—Huck-a-Back and Kindred Weaves—Grecian Weaves—Linear Zigzag Weaves.

Chapter V., BEDFORD CORDS.—Plain Calico-ribbed Bedford Cords—Plain Twill-ribbed Bedford Cords—Figured Bedford Cords—Tabulated Data of Particulars relating to the Manufacture of Seventeen Varieties of Bedford Cord Fabrics described in this Chapter.

[*Continued on next page*.

CONTENTS OF "GRAMMAR OF TEXTILE DESIGN"—*continued.*

Chapter VI., Backed Fabrics.—Weft-backed Fabrics—Warp-backed Fabrics—Reversible or Double-faced Fabrics.

Chapter VII., Fustians.—**Varieties of Fustians.**—Imperials or Swansdowns—Cantoons or Diagonals—Moleskins—Beaverteens—**Velveteens** and Velveteen Cutting—Ribbed or Corded Velveteen—Figured Velveteen—**Corduroy**—Figured Corduroy—Corduroy Cutting Machines.

Chapter VIII., Terry Pile Fabrics.—Methods of producing Terry Pile on Textile Fabrics—Terry-forming Devices—Varieties of Terry Fabrics—Action of the Reed in Relation to Shedding—Figured Terry Weaving—Practical Details of Terry Weaving.

Chapter IX., Gauze and Leno Fabrics.—**Gauze, Net Leno, and Leno Brocade Varieties of Cross-Weaving.**—Plain Gauze, and a Heald Gauze or Leno Harness—Net Leno Fabrics—Gauze and Net Leno Figuring by means of several Back Standard Healds to each Doup Heald—**Leno Specialities produced by a System of Crossing Warp Ends in *front* of the Reed**—A Device for the Production of Special Leno Effects—Full Cross Leno Fabrics—Relative Merits of a Top and a Bottom Doup Harness—Relative Merits of Different Types of Dobbies for Gauze and Leno Fabrics—Shaking Devices for Leno Weaving—Practical Details of Leno Weaving—**Tempered Steel-wire Doup Harnesses for Cross-weaving**—Mock or Imitation Leno Fabrics.

Chapter X., Tissue, Lappet, and Swivel Figuring; also Ondulé Effects, and Looped Fabrics.—**Tissue Figuring**—Madras Muslin Curtains—**Lappet Figuring**—Spot Lappet Figuring—**Swivel Figuring—Woven Ondulé Effects**—Loom for Weaving Ondulé Effects—Weft Ondulé Effects—**Looped Fabrics.**—Index.

ART NEEDLEWORK AND DESIGN. POINT LACE. A Manual of Applied Art for Secondary Schools and Continuation Classes. By M. E. Wilkinson. Oblong quarto. With 22 Plates. Bound in Art Linen. Price 3s. 6d. net. (Post free, 3s. 10d. home; 4s. abroad.)

Contents.

Sampler of Lace Stitches—Directions for working Point Lace, tracing Patterns, etc.—List of Materials and Implements required for working. Plates I., Simple Lines, Straight and Slanting, and Designs formed from them. II., Patterns formed from Lines in previous Lesson. III., Patterns formed from Lines in previous Lesson. IV., Simple Curves, and Designs formed from them. V., Simple Leaf form, and Designs formed from it. VI., Elementary Geometrical forms, with Definitions. VII., Exercises on previous Lessons. VIII., Filling of a Square, Oblong and Circle with Lace Stitches. IX., Design for Tie End, based on simple Leaf form. X., Lace Butterflies (Freehand). XI., Twenty simple Designs evolved from Honiton Braid Leaf. XII., Design for Lace Handkerchief, based on previous Lesson. XIII., Design for Tea-cosy. XIV., Freehand Lace Collar. XV., Freehand Lace Cuff (to match). XVI., Application of Spray from Lesson XI. XVII., Adaptation of Curves within a Square, for Lace Cushion Centre. XVIII., Conventional Spray for corner of Tea-cloth. XIX., Geometrical form for Rosebowl D'Oyley, to be originally filled in. XX., Geometrical form for Flower-vase D'Oyley, to be originally filled in. Each Lesson contains Instructions for Working, and application of new Stitches from Sampler.

HOME LACE-MAKING. A Handbook for Teachers and Pupils. By M. E. W. Milroy. Crown 8vo. 64 pp. With 3 Plates and 9 Diagrams. Price 1s. net. (Post free, 1s. 3d. home; 1s. 4d. abroad.)

THE CHEMISTRY OF HAT MANUFACTURING. Lectures delivered before the Hat Manufacturers' Association. By Watson Smith, F.C.S., F.I.C. Revised and Edited by Albert Shonk. Crown 8vo. 132 pp. 16 Illustrations. Price 7s. 6d. net. (Post free, 7s. 9d. home; 7s. 10d. abroad.)

THE TECHNICAL TESTING OF YARNS AND TEXTILE FABRICS. With Reference to Official Specifications. Translated from the German of Dr. J. Herzfeld. Second Edition. Sixty-nine Illustrations. 200 pp. Demy 8vo. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. abroad.)

DECORATIVE AND FANCY TEXTILE FABRICS. By R. T. Lord. For Manufacturers and Designers of Carpets, Damask, Dress and all Textile Fabrics. 200 pp. Demy 8vo. 132 Designs and Illustrations. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

THEORY AND PRACTICE OF DAMASK WEAVING. By H. Kinzer and K. Walter. Royal 8vo. Eighteen Folding Plates. Six Illustrations. Translated from the German. 110 pp. Price 8s. 6d. net. (Post free, 9s. home; 9s. 6d. abroad.)

TEXTILE BOOKS—*continued.*

Contents.

The Various Sorts of Damask Fabrics—Drill (Ticking, Handloom-made)—Whole Damask for Tablecloths—Damask with Ground- and Connecting-warp Threads—Furniture Damask—Lampas or Hangings—Church Damasks—**The Manufacture of Whole Damask**—Damask Arrangement with and without Cross-Shedding—The Altered Cone-arrangement—The Principle of the Corner Lifting Cord—The Roller Principle—The Combination of the Jacquard with the so-called Damask Machine—The Special Damask Machine—The Combination of Two Tyings.

FAULTS IN THE MANUFACTURE OF WOOLLEN GOODS AND THEIR PREVENTION. By NICOLAS REISER. Translated from the Second German Edition. Crown 8vo. Sixty-three Illustrations. 170 pp. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

Improperly Chosen Raw Material or Improper Mixtures—Wrong Treatment of the Material in Washing, Carbonisation, Drying, Dyeing and Spinning—Improper Spacing of the Goods in the Loom—Wrong Placing of Colours—Wrong Weight or Width of the Goods—Breaking of Warp and Weft Threads—Presence of Doubles, Singles, Thick, Loose, and too Hard Twisted Threads as well as Tangles, Thick Knots and the Like—Errors in Cross-weaving—Inequalities, *i.e.*, Bands and Stripes—Dirty Borders—Defective Selvedges—Holes and Buttons—Rubbed Places—Creases—Spots—Loose and Bad Colours—Badly Dyed Selvedges—Hard Goods—Brittle Goods—Uneven Goods—Removal of Bands, Stripes, Creases and Spots.

SPINNING AND WEAVING CALCULATIONS, especially relating to Woollens. From the German of N. REISER. Thirty-four Illustrations. Tables. 160 pp. Demy 8vo. 1904. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. abroad.)

Contents.

Calculating the Raw Material—Proportion of Different Grades of Wool to Furnish a Mixture at a Given Price—Quantity to Produce a Given Length—Yarn Calculations—Yarn Number—Working Calculations—Calculating the Reed Count—Cost of Weaving, etc.

WATERPROOFING OF FABRICS. By Dr. S. MIERZINSKI. Crown 8vo. 104 pp. 29 Illus. Price 5s. net. (Post free, 5s. 3d. home; 5s. 4d. abroad.)

Contents.

Introduction—Preliminary Treatment of the Fabric—Waterproofing with Acetate of Alumina—Impregnation of the Fabric—Drying—Waterproofing with Paraffin—Waterproofing with Ammonium Cuprate—Waterproofing with Metallic Oxides—Coloured Waterproof Fabrics—Waterproofing with Gelatine, Tannin, Caseinate of Lime and other Bodies—Manufacture of Tarpaulin—British Waterproofing Patents—Index.

HOW TO MAKE A WOOLLEN MILL PAY. By JOHN MACKIE. Crown 8vo. 76 pp. Price 3s. 6d. net. (Post free, 3s. 9d. home; 3s. 10d. abroad.)

Contents.

Blends, Piles, or Mixtures of Clean Scoured Wools—Dyed Wool Book—The Order Book—Pattern Duplicate Books—Management and Oversight—Constant Inspection of Mill Departments—Importance of Delivering Goods to Time, Shade, Strength, etc.—Plums.

(For "Textile Soaps and Oils" see p. 7.)

Dyeing, Colour Printing, Matching and Dye-stuffs.

THE COLOUR PRINTING OF CARPET YARNS. Manual for Colour Chemists and Textile Printers. By DAVID PATERSON, F.C.S. Seventeen Illustrations. 136 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Structure and Constitution of Wool Fibre—Yarn Scouring—Scouring Materials—Water for Scouring—Bleaching Carpet Yarns—Colour Making for Yarn Printing—Colour Printing Pastes—Colour Recipes for Yarn Printing—Science of Colour Mixing—Matching of Colours—"Hank" Printing—Printing Tapestry Carpet Yarns—Yarn Printing—Steaming Printed Yarns—Washing of Steamed Yarns—Aniline Colours Suitable for Yarn Printing—Glossary of Dyes and Dye-wares used in Wood Yarn Printing—Appendix.

THE SCIENCE OF COLOUR MIXING. A Manual intended for the use of Dyers, Calico Printers and Colour Chemists. By DAVID PATERSON, F.C.S. Forty-one Illustrations, **Five Coloured Plates, and Four Plates showing Eleven Dyed Specimens of Fabrics.** 132 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Colour a Sensation; Colours of Illuminated Bodies; Colours of Opaque and Transparent Bodies; Surface Colour—Analysis of Light; Spectrum; Homogeneous Colours; Ready Method of Obtaining a Spectrum—Examination of Solar Spectrum; The Spectroscope and Its Construction; Colourists' Use of the Spectroscope—Colour by Absorption; Solutions and Dyed Fabrics; Dichroic Coloured Fabrics in Gaslight—Colour Primaries of the Scientist *versus* the Dyer and Artist; Colour Mixing by Rotation and Lye Dyeing; Hue, Purity, Brightness; Tints; Shades, Scales, Tones, Sad and Sombre Colours—Colour Mixing; Pure and Impure Greens, Orange and Violets; Large Variety of Shades from few Colours; Consideration of the Practical Primaries: Red, Yellow and Blue—Secondary Colours; Nomenclature of Violet and Purple Group; Tints and Shades of Violet; Changes in Artificial Light—Tertiary Shades; Broken Hues; Absorption Spectra of Tertiary Shades—Appendix: Four Plates with Dyed Specimens Illustrating Text—Index.

DYERS' MATERIALS: An Introduction to the Examination, Evaluation and Application of the most important Substances used in Dyeing, Printing, Bleaching and Finishing. By PAUL HEERMAN, Ph.D. Translated from the German by A. C. WRIGHT, M.A. (Oxon.), B.Sc. (Lond.). Twenty-four Illustrations. Crown 8vo. 150 pp. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

COLOUR MATCHING ON TEXTILES. A Manual intended for the use of Students of Colour Chemistry, Dyeing and Textile Printing. By DAVID PATERSON, F.C.S. Coloured Frontispiece. Twenty-nine Illustrations and **Fourteen Specimens of Dyed Fabrics**. Demy 8vo. 132 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Colour Vision and Structure of the Eye—Perception of Colour—Primary and Complementary Colour Sensations—Daylight for Colour Matching—Selection of a Good Pure Light—Diffused Daylight, Direct Sunlight, Blue Skylight, Variability of Daylight, etc., etc.—Matching of Hues—Purity and Luminosity of Colours—Matching Bright Hues—Aid of Tinted Films—Matching Difficulties Arising from Contrast—Examination of Colours by Reflected and Transmitted Lights—Effect of Lustre and Transparency of Fibres in Colour Matching—Matching of Colours on Velvet Pile—Optical Properties of Dye-stuffs, Dichroism, Fluorescence—Use of Tinted Mediums—Orange Film—Defects of the Eye—Yellowing of the Lens—Colour Blindness, etc.—Matching of Dyed Silk Trimmings and Linings and Bindings—Its Difficulties—Behaviour of Shades in Artificial Light—Colour Matching of Old Fabrics, etc.—Examination of Dyed Colours under the Artificial Lights—Electric Arc, Magnesium and Dufton, Gardner Lights, Welsbach, Acetylene, etc.—Testing Qualities of an Illuminant—Influence of the Absorption Spectrum in Changes of Hue under the Artificial Lights—Study of the Causes of Abnormal Modifications of Hue, etc.

COLOUR: A HANDBOOK OF THE THEORY OF COLOUR. By GEORGE H. HURST, F.C.S. **With Ten Coloured Plates** and Seventy-two Illustrations. 160 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Colour and Its Production—Cause of Colour in Coloured Bodies—Colour Phenomena and Theories—The Physiology of Light—Contrast—Colour in Decoration and Design—Measurement of Colour.

Reissue of

THE ART OF DYEING WOOL, SILK AND COTTON. Translated from the French of M. HELLOT, M. MACQUER and M. LE PILEUR D'APLIGNY. First Published in English in 1789. Six Plates. Demy 8vo. 446 pp. Price 5s. net. (Post free, 5s. 6d. home; 6s. abroad.)

Contents.

Part I., **The Art of Dyeing Wool and Woollen Cloth, Stuffs, Yarn, Worsted, etc.** Part II., **The Art of Dyeing Silk.** Part III., **The Art of Dyeing Cotton and Linen Thread, together with the Method of Stamping Silks, Cottons, etc.**

THE CHEMISTRY OF DYE-STUFFS. By Dr. GEORG VON GEORGIEVICS. Translated from the Second German Edition. 412 pp. Demy 8vo. Price 10s. 6d. net. (Post free, 11s. home; 11s. 6d. abroad.)

Contents.

Introduction—Coal Tar—Intermediate Products in the Manufacture of Dye-stuffs—The Artificial Dye-stuffs (Coal-tar Dyes)—Nitroso Dye-stuffs—Nitro Dye-stuffs—Azo Dye-stuffs—Substantive Cotton Dye-stuffs—Azoxystilbene Dye-stuffs—Hydrazones—Ketoneimides—Triphenylmethane Dye-stuffs—Rosolic Acid Dye-stuffs—Xanthene Dye-stuffs—Xanthone Dye-stuffs—Flavones—Oxyketone Dye-stuffs—Quinoline and Acridine Dye-stuffs—Quinonimide or Diphenylamine Dye-stuffs—The Azine Group: Eurhodines, Safranines and Indulines—Eurhodines—Safranines—Quinoxalines—Indigo—Dye-stuffs of Unknown Constitution—Sulphur or Sulphine Dye-stuffs—Development of the Artificial Dye-stuff Industry—The Natural Dye-stuffs—Mineral Colours—Index.

THE DYEING OF COTTON FABRICS: A Practical Handbook for the Dyer and Student. By FRANKLIN BEECH, Practical Colourist and Chemist. 272 pp. Forty-four Illustrations of Bleaching and Dyeing Machinery. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Structure and Chemistry of the Cotton Fibre—Scouring and Bleaching of Cotton—Dyeing Machinery and Dyeing Manipulations—Principles and Practice of Cotton Dyeing—Direct Dyeing; Direct Dyeing followed by Fixation with Metallic Salts; Direct Dyeing followed by Fixation with Developers; Direct Dyeing followed by Fixation with Couplers; Dyeing on Tannic Mordant; Dyeing on Metallic Mordant; Production of Colour Direct upon Cotton Fibres; Dyeing Cotton by Impregnation with Dye-stuff Solution—Dyeing Union (Mixed Cotton and Wool) Fabrics—Dyeing Half Silk (Cotton-Silk, Satin) Fabrics—Operations following Dyeing—Washing, Soaping, Drying—Testing of the Colour of Dyed Fabrics—Experimental Dyeing and Comparative Dye Testing—Index.

The book contains numerous recipes for the production on Cotton Fabrics of all kinds of a great range of colours.

THE DYEING OF WOOLLEN FABRICS. By FRANKLIN BEECH, Practical Colourist and Chemist. Thirty-three Illustrations. Demy 8vo. 228 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

The Wool Fibre—Structure, Composition and Properties—Processes Preparatory to Dyeing—Scouring and Bleaching of Wool—Dyeing Machinery and Dyeing Manipulations—Loose Wool Dyeing, Yarn Dyeing and Piece Dyeing Machinery—The Principles and Practice of Wool Dyeing—Properties of Wool Dyeing—Methods of Wool Dyeing—Groups of Dyes—Dyeing with the Direct Dyes—Dyeing with Basic Dyes—Dyeing with Acid Dyes—Dyeing with Mordant Dyes—Level Dyeing—Blacks on Wool—Reds on Wool—Mordanting of Wool—Orange Shades on Wool—Yellow Shades on Wool—Green Shades on Wool—Blue Shades on Wool—Violet Shades on Wool—Brown Shades on Wool—Mode Colours on Wool—Dyeing Union (Mixed Cotton Wool) Fabrics—Dyeing of Gloria—Operations following Dyeing—Washing, Soaping, Drying—Experimental Dyeing and Comparative Dye Testing—Testing of the Colour of Dyed Fabrics—Index.

Bleaching and Washing.

A PRACTICAL TREATISE ON THE BLEACHING OF LINEN AND COTTON YARN AND FABRICS. By L. TAILFER, Chemical and Mechanical Engineer. Translated from the French by JOHN GEDDES MCINTOSH. Demy 8vo. 303 pp. Twenty Illus. Price 12s. 6d. net. (Post free, 13s. home; 13s. 6d. abroad.)

Cotton Spinning and Combing.

COTTON SPINNING (First Year). By THOMAS THORNLEY, Spinning Master, Bolton Technical School. 160 pp. Eighty-four Illustrations. Crown 8vo. Second Impression. Price 3s. net. (Post free, 3s. 4d. home; 3s. 6d. abroad.)

Contents.

Syllabus and Examination Papers of the City and Guilds of London Institute—Cultivation, Classification, Ginning, Baling and Mixing of the Raw Cotton—Bale-Breakers, Mixing Lattices and Hopper Feeders—Opening and Scutching—Carding—Indexes.

COTTON SPINNING (Intermediate, or Second Year). By THOMAS THORNLEY. Second Impression. 180 pp. Seventy Illustrations. Crown 8vo. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

Syllabuses and Examination Papers of the City and Guilds of London Institute—The Combing Process—The Drawing Frame—Bobbin and Fly Frames—Mule Spinning—Ring Spinning—General Indexes.

COTTON SPINNING (Honours, or Third Year). By THOMAS THORNLEY. 216 pp. Seventy-four Illustrations. Crown 8vo. Second Edition. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

Syllabuses and Examination Papers of the City and Guilds of London Institute—Cotton—The Practical Manipulation of Cotton Spinning Machinery—Doubling and Winding—Reeling—Warping—Production and Costs—Main Driving—Arrangement of Machinery and Mill Planning—Waste and Waste Spinning—Indexes.

COTTON COMBING MACHINES. By THOS. THORNLEY, Spinning Master, Technical School, Bolton. Demy 8vo. 117 Illustrations. 300 pp. Price 7s. 6d. net. (Post free, 8s. home; 8s. 6d. abroad.)

Contents.

The Sliver Lap Machine and the Ribbon Cap Machine—General Description of the Heilmann Comber—The Cam Shaft—On the Detaching and Attaching Mechanism of the Comber—Resetting of Combers—The Erection of a Heilmann Comber—Stop Motions: Various Calculations—Various Notes and Discussions—Cotton Combing Machines of Continental Make—Index.

Flax, Hemp and Jute Spinning.

MODERN FLAX, HEMP AND JUTE SPINNING AND TWISTING. A Practical Handbook for the use of Flax, Hemp and Jute Spinners, Thread, Twine and Rope Makers. By HERBERT R. CARTER, Mill Manager, Textile Expert and Engineer, Examiner in Flax Spinning to the City and Guilds of London Institute. Demy 8vo. 1907. With 92 Illustrations. 200 pp. Price 7s. 6d. net. (Post free, 7s. 9d. home; 8s. abroad.)

Contents.

Raw Fibre.—Origin of Flax—Hemp and Jute Fibre—Description of the Plants—Mode of Cultivation—Suitable Climate and Soil—Sowing—Harvesting—Rippling Flax and Hemp—Water Retting—Dew Retting—Extraction of the Fibre—Marketing the Fibre—Bracquing—Flax, Hemp and Jute Marks—Comparative Prices—Ports of Export—Trade Centres—Fibre Selling Conditions—Duty on Fibre—Fibre Exports. **Hackling.**—Sorting and Storing the Raw Fibre—Softening Hemp and Jute—Jute Batching—Cutting—Piecing Out—Roughing—Hackling by Hand and Machine—Tippling—Sorting—Ventilation of Hackling Rooms. **Sliver Formation.**—Spreading Line—Heavy Spreading System—Good's Combined Hackle and Spreader—Jute Breaking and Carding—Flax and Hemp Tow Carding—Bell Calculation—Clock System—Theory of Spreading. **Line and Tow Preparing.**—Drawing and Doubling—Draft Calculation—Set Calculation—Tow Combing—Compound Systems—Automatic Stop Motions and Independent Heads—Details of Preparing Machinery—Ventilation—Humidification. **Gill Spinning.**—Gill Spinning for Shoe Threads, Rope Yarns, Binder and Trawl Twines—The Automatic Gill Spinner—Rope and Reaper Yarn Numbering. **The Flax, Hemp and Jute Roving Frame.**—Bobbin Winding—Differential Motion—Twist Calculation—Practical Changing—Rove Stock. **Dry and Half-Dry Spinning.**—Flyer and Ring Frames—Draft and Twist Calculation—Bobbin Dragging—Reaches—Set of Breast Beam and Tin-rod. **Wet Spinning** of Flax, Hemp and Tow—Hot and Cold Water Spinning—Improvements in the Water Trough—Turn off and Speed of Spindles—Reaches—Belting—Band Tying—Tape Driving—Oiling—Black Threads—Cuts per Spindle—Ventilation of the Wet Spinning Room. **Yarn Department.**—Reeling—Cop Winding—Cheese and Spool Winding—Balling Shoe Thread, Reaper Yarn, etc.—Yarn Drying and Conditioning—Yarn Bundling—Yarn Baling—Weight of Yarn—Yarn Tables—Duty on Yarn Imports. **Manufacture of Threads, Twines and Cords.**—Hank Winding—Wet and Dry Twisting—Cabling—Fancy Yarns—Twine Laying—Sizing and Polishing Threads and Twines—Softening Threads—Skeining Threads—Balling Twines—Leeson's Universal Winder—Randing Twines—Spooling Sewing Threads—Comparative Prices of Flax and Hemp Cords, Lines and Threads. **Rope Making.**—Construction of Hawsers and Cables—Stranding—Laying and Closing—Compound Rope Machines—Rules for Rope Makers—Weight of Ropes—Balling and Coiling Ropes. **Mechanical Department.**—Boilers, Engines and Turbines—Power Transmission by Belts and Ropes—Electric Light and Power Transmission—Fans—Oils and Oiling—Repairs—Fluting. **Mill Construction.**—Flax, Hemp and Jute Spinning Mills and Ropeworks—Heating—Roofs—Chimneys, etc.

Collieries and Mines.

RECOVERY WORK AFTER PIT FIRES. By Robert Lamprecht, Mining Engineer and Manager. Translated from the German. Illustrated by Six large Plates, containing Seventy-six Illustrations. 175 pp., demy 8vo. Price 10s. 6d. net. (Post free, 10s. 10d. home; 11s. abroad.)

Contents.

Causes of Pit Fires—Preventive Regulations: (1) The Outbreak and Rapid Extension of a Shaft Fire can be most reliably prevented by Employing little or no Combustible Material in the Construction of the Shaft; (2) Precautions for Rapidly Localising an Outbreak of Fire in the Shaft; (3) Precautions to be Adopted in case those under 1 and 2 Fail or Prove Inefficient. Precautions against Spontaneous Ignition of Coal. Precautions for Preventing Explosions of Fire-damp and Coal Dust. Employment of Electricity in Mining, particularly in Fiery Pits. Experiments on the Ignition of Fire-damp Mixtures and Clouds of Coal Dust by Electricity—**Indications of an Existing or Incipient Fire—Appliances for Working in Irrespirable Gases:** Respiratory Apparatus; Apparatus with Air Supply Pipes; Reservoir Apparatus; Oxygen Apparatus—**Extinguishing Pit Fires:** (*a*) Chemical Means; (*b*) Extinction with Water. Dragging down the Burning Masses and Packing with Clay; (*c*) Insulating the Seat of the Fire by Dams. Dam Building. Analyses of Fire Gases. Isolating the Seat of a Fire with Dams: Working in Irrespirable Gases ("Gas-diving"): Air-Lock Work. Complete Isolation of the Pit. Flooding a Burning Section isolated by means of Dams. Wooden Dams: Masonry Dams. Examples of Cylindrical and Dome-shaped Dams. Dam Doors: Flooding the Whole Pit—**Rescue Stations:** (*a*) Stations above Ground; (*b*) Underground Rescue Stations—**Spontaneous Ignition of Coal in Bulk**—Index.

VENTILATION IN MINES. By Robert Wabner, Mining Engineer. Translated from the German. Royal 8vo. Thirty Plates and Twenty-two Illustrations. 240 pp. Price 10s. 6d. net. (Post free, 11s. home; 11s. 3d. abroad.)

Contents.

The Causes of the Contamination of Pit Air—The Means of Preventing the Dangers resulting from the Contamination of Pit Air—Calculating the Volume of Ventilating Current necessary to free Pit Air from Contamination—Determination of the Resistance Opposed to the Passage of Air through the Pit—Laws of Resistance and Formulæ therefor—Fluctuations in the Temperament or Specific Resistance of a Pit—Means for Providing a Ventilating Current in the Pit—Mechanical Ventilation—Ventilators and Fans—Determining the Theoretical, Initial, and True (Effective) Depression of the Centrifugal Fan—New Types of Centrifugal Fan of Small Diameter and High Working Speed—Utilising the Ventilating Current to the utmost Advantage and distributing the same through the Workings—Artificially retarding the Ventilating Current—Ventilating Preliminary Workings—Blind Headings—Separate Ventilation—Supervision of Ventilation—Index.

HAULAGE AND WINDING APPLIANCES USED IN MINES. By Carl Volk. Translated from the German. Royal 8vo. With Six Plates and 148 Illustrations. 150 pp. Price 8s. 6d. net. (Post free, 9s. home; 9s. 3d. abroad.)

Contents.

Haulage Appliances—Ropes—Haulage Tubs and Tracks—Cages and Winding Appliances—Winding Engines for Vertical Shafts—Winding without Ropes—Haulage in Levels and Inclines—The Working of Underground Engines—Machinery for Downhill Haulage.

Dental Metallurgy.

DENTAL METALLURGY: MANUAL FOR STUDENTS AND DENTISTS. By A. B. Griffiths, Ph.D. Demy 8vo. Thirty-six Illustrations. 200 pp. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Introduction—Physical Properties of the Metals—Action of Certain Agents on Metals—Alloys—Action of Oral Bacteria on Alloys—Theory and Varieties of Blowpipes—Fluxes—Furnaces and Appliances—Heat and Temperature—Gold—Mercury—Silver—Iron—Copper—Zinc—Magnesium—Cadmium—Tin—Lead—Aluminium—Antimony—Bismuth—Palladium—Platinum—Iridium—Nickel—Practical Work—Weights and Measures.

Engineering, Smoke Prevention and Metallurgy.

THE PREVENTION OF SMOKE. Combined with the Economical Combustion of Fuel. By W. C. POPPLEWELL, M.Sc., A.M.Inst., C.E., Consulting Engineer. Forty-six Illustrations. 190 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. 3d. abroad.)

Contents.

Fuel and Combustion— Hand Firing in Boiler Furnaces—Stoking by Mechanical Means—Powdered Fuel—Gaseous Fuel—Efficiency and Smoke Tests of Boilers—Some Standard Smoke Trials—The Legal Aspect of the Smoke Question—The Best Means to be adopted for the Prevention of Smoke—Index.

GAS AND COAL DUST FIRING. A Critical Review of the Various Appliances Patented in Germany for this purpose since 1885. By ALBERT PÜTSCH. 130 pp. Demy 8vo. Translated from the German. With 103 Illustrations. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Generators—Generators Employing Steam—Stirring and Feed Regulating Appliances—Direct Generators—Burners—Regenerators and Recuperators—Glass Smelting Furnaces—Metallurgical Furnaces—Pottery Furnace—Coal Dust Firing—Index.

THE HARDENING AND TEMPERING OF STEEL IN THEORY AND PRACTICE. By FRIDOLIN REISER. Translated from the German of the Third Edition. Crown 8vo. 120 pp. Price 5s. net. (Post free, 5s. 3d. home; 5s. 4d. abroad.)

Contents.

Steel—Chemical and Physical Properties of Steel, and their Casual Connection—Classification of Steel according to Use—Testing the Quality of Steel — Steel-Hardening—Investigation of the Causes of Failure in Hardening—Regeneration of Steel Spoilt in the Furnace—Welding Steel—Index.

SIDEROLOGY: THE SCIENCE OF IRON (The Constitution of Iron Alloys and Slags). Translated from German of HANNS FREIHERR v. JÜPTNER. 350 pp. Demy 8vo. Eleven Plates and Ten Illustrations. Price 10s. 6d. net. (Post free, 11s. home; 11s. 6d. abroad.)

Contents.

The Theory of Solution.—Solutions—Molten Alloys—Varieties of Solutions—Osmotic Pressure—Relation between Osmotic Pressure and other Properties of Solutions—Osmotic Pressure and Molecular Weight of the Dissolved Substance—Solutions of Gases—Solid Solutions—Solubility—Diffusion—Electrical Conductivity—Constitution of Electrolytes and Metals—Thermal Expansion. **Micrography.**—Microstructure—The Micrographic Constituents of Iron—Relation between Micrographical Composition, Carbon-Content, and Thermal Treatment of Iron Alloys—The Microstructure of Slags. **Chemical Composition of the Alloys of Iron.**—Constituents of Iron Alloys—Carbon—Constituents of the Iron Alloys, Carbon—Opinions and Researches on Combined Carbon—Opinions and Researches on Combined Carbon—Applying the Curves of Solution deduced from the Curves of Recalescence to the Determination of the Chemical Composition of the Carbon present in Iron Alloys—The Constituents of Iron—Iron—The Constituents of Iron Alloys—Manganese—Remaining Constituents of Iron Alloys—A Silicon—Gases. **The Chemical Composition of Slag.**—Silicate Slags—Calculating the Composition of Silicate Slags—Phosphate Slags—Oxide Slags—Appendix—Index.

EVAPORATING, CONDENSING AND COOLING APPARATUS. Explanations, Formulæ and Tables for Use in Practice. By E. HAUSBRAND, Engineer. Translated by A. C. WRIGHT, M.A. (Oxon.), B.Sc. (Lond.). With Twenty-one Illustrations and Seventy-six Tables. 400 pp. Demy 8vo. Price 10s. 6d. net. (Post free, 11s. home; 11s. 6d. abroad.)

Contents.

*Re*Coefficient of Transmission of Heat, k/, and the Mean Temperature Difference, θ/m—Parallel and Opposite Currents—Apparatus for Heating with Direct Fire—The Injection of Saturated Steam—Superheated Steam—Evaporation by Means of Hot Liquids—The Transference of Heat in General, and Transference by means of Saturated Steam in Particular—The Transference of Heat from Saturated Steam in Pipes (Coils) and Double Bottoms—Evaporation in a Vacuum—The Multiple-effect Evaporator—Multiple-effect Ev porators

Contents of "Evaporating, Condensing and Cooling Apparatus".—*continued.*

from which Extra Steam is Taken—The Weight of Water which must be Evaporated from 100 Kilos. of Liquor in order its Original Percentage of Dry Materials from 1-25 per cent. up to 20-70 per cent.—The Relative Proportion of the Heating Surfaces in the Elements of the Multiple Evaporator and their Actual Dimensions—The Pressure Exerted by Currents of Steam and Gas upon Floating Drops of Water—The Motion of Floating Drops of Water upon which Press Currents of Steam—The Splashing of Evaporating Liquids—The Diameter of Pipes for Steam, Alcohol, Vapour and Air—The Diameter of Water Pipes—The Loss of Heat from Apparatus and Pipes to the Surrounding Air, and Means for Preventing the Loss—Condensers—Heating Liquids by Means of Steam—The Cooling of Liquids—The Volumes to be Exhausted from Condensers by the Air-pumps—A Few Remarks on Air-pumps and the Vacua they Produce—The Volumetric Efficiency of Air-pumps—The Volumes of Air which must be Exhausted from a Vessel in order to Reduce its Original Pressure to a Certain Lower Pressure—Index.

Sanitary Plumbing, Electric Wiring, Metal Work, etc.

EXTERNAL PLUMBING WORK. A Treatise on Lead Work for Roofs. By JOHN W. HART, R.P.C. 180 Illustrations. 272 pp. Demy 8vo. Second Edition Revised. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

HINTS TO PLUMBERS ON JOINT WIPING, PIPE BENDING AND LEAD BURNING. Third Edition, Revised and Corrected. By JOHN W. HART, R.P.C. 184 Illustrations. 313 pp. Demy 8vo. Price 7s. 6d. net. (Post free, 8s. home; 8s. 6d. abroad.)

Contents.

Pipe Bending — Pipe Bending (continued) — Pipe Bending (continued) — Square Pipe Bendings—Half-circular Elbows—Curved Bends on Square Pipe—Bossed Bends—Curved Plinth Bends—Rain-water Shoes on Square Pipe—Curved and Angle Bends—Square Pipe Fixings—Joint-wiping—Substitutes for Wiped Joints—Preparing Wiped Joints—Joint Fixings—Plumbing Irons—Joint Fixings—Use of "Touch" in Soldering—Underhand Joints—Blown and Copper Bit Joints—Branch Joints—Branch Joints (continued)—Block Joints—Block Joints (continued)—Block Fixings—Astragal Joints—Pipe Fixings—Large Branch Joints—Large Underhand Joints—Solders—Autogenous Soldering or Lead Burning—Index.

SANITARY PLUMBING AND DRAINAGE. By JOHN W. HART. Demy 8vo. With 208 Illustrations. 250 pp. 1904. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

Sanitary Surveys—Drain Testing—Drain Testing with Smoke—Testing Drains with Water—Drain Plugs for Testing—Sanitary Defects—Closets—Baths and Lavatories—House Drains—Manholes—Iron Soil Pipes—Lead Soil Pipes—Ventilating Pipes—Water-closets—Flushing Cisterns — Baths — Bath Fittings — Lavatories — Lavatory Fittings—Sinks—Waste Pipes—Water Supply — Ball Valves — Town House Sanitary Arrangements — Drainage—Jointing Pipes—Accessible Drains—Iron Drains—Iron Junctions—Index.

ELECTRIC WIRING AND FITTING FOR PLUMBERS AND GASFITTERS. By SYDNEY F. WALKER, R.N., M.I.E.E., M.I.Min.E., A.M.Inst.C.E., etc., etc. Crown 8vo. 150 pp. With Illustrations and Tables. Price 5s. net. (Post free, 5s. 3d. home; 5s. 6d. abroad.)

Contents.

Chapter I., **Electrical Terms Used.**—Pressure and Current—The Volt—Ampère—Electrical Resistance—Earth—Continuous and Alternating Currents—The Electric Circuit—Leakage—Heating of Conductors—Size and Forms of Conductors—The Kilowatt—Loss of Pressure—Arrangement of Conductors—Looping In—The Three Wire System—Switches—Fuses—Circuit—Breakers. II., **The Insulation of Wires, Their Protection. Fixing, etc.**—Conductors Insulated with Paper and Similar Materials—Sparking between Conductors—Dialite Insulation—Flexible Cords—Concentric Conductors—Twin Conductors—Three-Core Cables—Fireproof Insulation for Conductors—Jointing—T Joints—Covering T Joints in Vulcanized Rubber Cables. III., **Fixing the Wiring and Cables.**—Laying Out the Route—The Protection of the Wires and Cables—Wood Casing—Metallic Conduits—Non-Metallic Conductors—Fixing the Conduits and Running Wires in Them—Drawing Wire into Tubes—To Avoid Shock. IV., **Lamps.**—The Incandescent Lamp—Lamp Holders—Lamp Fittings—The Nernst Lamp. V., **Switches, Fuses, Distribution Boards, etc.**—The Electricity Meter—Prepayment Meters.

THE PRINCIPLES AND PRACTICE OF DIPPING, BURNISHING, LACQUERING AND BRONZING BRASS WARE. By W. Norman Brown. 35 pp. Crown 8vo. Price 2s. net. (Post free, 2s. 3d. home and abroad.)

A HANDBOOK ON JAPANNING AND ENAMELLING FOR CYCLES, BEDSTEADS, TINWARE, ETC. By William Norman Brown. 52 pp. and Illustrations. Crown 8vo. Price 2s. net. (Post free, 2s. 3d. home and abroad.)

THE PRINCIPLES OF HOT WATER SUPPLY. By John W. Hart, R.P.C. With 129 Illustrations. 177 pp., demy 8vo. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. abroad.)

Contents.

House Decorating and Painting.

THREE HUNDRED SHADES AND HOW TO MIX THEM. For Architects, Painters and Decorators. By A. Desaint, Artistic Interior Decorator of Paris. The book contains 100 folio Plates, measuring 12 in. by 7 in., each Plate containing specimens of three artistic shades. These shades are all numbered, and their composition and particulars for mixing are fully given at thc beginning of the book. Each Plate is interleaved with grease-proof paper, and the volume is very artistically bound in art and linen with the Shield of the Painters' Guild impressed on the cover in gold and silver. Price 21s. net. (Post free, 21s. 6d. home; 22s. 6d. abroad.)

HOUSE DECORATING AND PAINTING. By W. Norman Brown. Eighty-eight Illustrations. 150 pp. Crown 8vo. Price 3s. 6d. net. (Post free, 3s. 9d. home and abroad.)

A HISTORY OF DECORATIVE ART. By W. Norman Brown. Thirty-nine Illustrations. 96 pp. Crown 8vo. Price 2s. 6d. net. (Post free, 2s. 9d. home and abroad.)

WORKSHOP WRINKLES for Decorators, Painters, Paper-hangers and Others. By W. N. Brown. Crown 8vo. 128 pp. Second Edition. Price 2s. 6d. net. (Post free, 2s. 9d. home; 2s. 10d. abroad.)

Brewing and Botanical.

HOPS IN THEIR BOTANICAL, AGRICULTURAL AND TECHNICAL ASPECT, AND AS AN ARTICLE OF COMMERCE. By Emmanuel Gross, Professor at the Higher Agricultural College, Tetschen-Liebwerd. Translated from the German. Seventy-eight Illustrations. 340 pp. Demy 8vo. Price 12s. 6d. net. (Post free, 13s. home; 13s. 6d. abroad.)

Contents.

Fruit and Seed—Propagation and Selection of the Hop—Varieties of the Hop: (*a*) Red Hops; (*b*) Green Hops; (*c*) Pale Green Hops—Classification according to the Period of Ripening: Early August Hops; Medium Early Hops; Late Hops—Injuries to Growth—Leaves Turning Yellow, Summer or Sunbrand, Cones Dropping Off, Honey Dew, Damage from Wind, Hail and Rain; Vegetable Enemies of the Hop: Animal Enemies of the Hop—Beneficial Insects on Hops—CULTIVATION—The Requirements of the Hop in Respect of Climate, Soil and Situation: Climate; Soil; Situation—Selection of Variety and Cuttings—Planting a Hop Garden: Drainage; Preparing the Ground; Marking-out for Planting; Planting; Cultivation and Cropping of the Hop Garden in the First Year—Work to be Performed Annually in the Hop Garden: Working the Ground; Cutting; The Non-cutting System; The Proper Performance of the Operation of Cutting: Method of Cutting: Close Cutting, Ordinary Cutting, The Long Cut, The Topping Cut; Proper Season for Cutting: Autumn Cutting, Spring Cutting; Manuring; Training the Hop Plant: Poled Gardens, Frame Training; Principal Types of Frames; Pruning, Cropping, Topping, and Leaf Stripping the Hop Plant; Picking, Drying and Bagging—Principal and Subsidiary Utilisation of Hops and Hop Gardens—Life of a Hop Garden; Subsequent Cropping—Cost of Production, Yield and Selling Prices.

Preservation and Storage—Physical and Chemical Structure of the Hop Cone—Judging the Value of Hops.

Statistics of Production—The Hop Trade—Index.

Timber and Wood Waste.

TIMBER: A Comprehensive Study of Wood in all its Aspects (Commercial and Botanical), showing the Different Applications and Uses of Timber in Various Trades, etc. Translated from the French of PAUL CHARPENTIER. Royal 8vo. 437 pp. 178 Illustrations. Price 12s. 6d. net. (Post free, 13s. home; 14s. abroad.)

Contents.

Physical and Chemical Properties of Timber—Composition of the Vegetable Bodies—Chief Elements—M. Fremy's Researches—Elementary Organs of Plants and especially of Forests—Different Parts of Wood Anatomically and Chemically Considered—General Properties of Wood—**Description of the Different Kinds of Wood**—Principal Essences with Caducous Leaves—Coniferous Resinous Trees—**Division of the Useful Varieties of Timber in the Different Countries of the Globe**—European Timber—African Timber—Asiatic Timber—American Timber—Timber of Oceania—**Forests**—General Notes as to Forests; their Influence—Opinions as to Sylviculture—Improvement of Forests—Unwooding and Rewooding—Preservation of Forests—Exploitation of Forests—Damage caused to Forests—Different Alterations—**The Preservation of Timber**—Generalities—Causes and Progress of Deterioration—History of Different Proposed Processes—Dessication—Superficial Carbonisation of Timber—Processes by Immersion—Generalities as to Antiseptics Employed—Injection Processes in Closed Vessels—The Boucherie System, Based upon the Displacement of the Sap—Processes for Making Timber Uninflammable—**Applications of Timber**—Generalities—Working Timber—Paving—Timber for Mines—Railway Traverses—Accessory Products—Gums—Works of M. Fremy—Resins—Barks—Tan—Application of Cork—The Application of Wood to Art and Dyeing—Different Applications of Wood—Hard Wood—Distillation of Wood—Pyroligneous Acid—Oil of Wood—Distillation of Resins—Index.

THE UTILISATION OF WOOD WASTE. Translated from the German of ERNST HUBBARD. Crown 8vo. 192 pp. Fifty Illustrations. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Contents.

General Remarks on the Utilisation of Sawdust—Employment of Sawdust as Fuel, with and without Simultaneous Recovery of Charcoal and the Products of Distillation—Manufacture of Oxalic Acid from Sawdust—Process with Soda Lye; Thorn's Process; Bohlig's Process—Manufacture of Spirit (Ethyl Alcohol) from Wood Waste—Patent Dyes (Organic Sulphides, Sulphur Dyes, or Mercapto Dyes)—Artificial Wood and Plastic Compositions from Sawdust—Production of Artificial Wood Compositions for Moulded Decorations—Employment of Sawdust for Blasting Powders and Gunpowders—Employment of Sawdust for Briquettes—Employment of Sawdust in the Ceramic Industry and as an Addition to Mortar—Manufacture of Paper Pulp from Wood—Casks—Various Applications of Sawdust and Wood Refuse—Calcium Carbide—Manure—Wood Mosaic Plaques—Bottle Stoppers—Parquetry—Fire-lighters—Carborundum—The Production of Wood Wool—Bark—Index.

Building and Architecture.

THE PREVENTION OF DAMPNESS IN BUILDINGS; with Remarks on the Causes, Nature and Effects of Saline, Efflorescences and Dry-rot, for Architects, Builders, Overseers, Plasterers, Painters and House Owners. By ADOLF WILHELM KEIM. Translated from the German of the second revised Edition by M. J. SALTER, F.I.C., F.C.S. Eight Coloured Plates and Thirteen Illustrations. Crown 8vo. 115 pp. Price 5s. net. (Post free, 5s. 3d. home; 5s. 4d. abroad.)

HANDBOOK OF TECHNICAL TERMS USED IN ARCHITECTURE AND BUILDING, AND THEIR ALLIED TRADES AND SUBJECTS. By AUGUSTINE C. PASSMORE. Demy 8vo. 380 pp. Price 7s. 6d. net. (Post free, 8s. home; 8s. 6d. abroad.)

The Preserving of Foods and Sweetmeats.

THE MANUFACTURE OF PRESERVED FOODS AND SWEETMEATS. By A. HAUSNER. With Twenty-eight Illustrations. Translated from the German of the third enlarged Edition. Crown 8vo. 225 pp. Price 7s. 6d. net. (Post free, 7s. 9d. home; 7s. 10d. abroad.)

Contents.

The Manufacture of Conserves—Introduction—The Causes of the Putrefaction of Food—The Chemical Composition of Foods—The Products of Decomposition—The Causes of Fermentation and Putrefaction—Preservative Bodies—The Various Methods of Preserving Food—The Preservation of Animal Food—Preserving Meat by Means of Ice—The Preservation of Meat by Charcoal—Preservation of Meat by Drying—The Preservation of Meat by the Exclusion of Air—The Appert Method—Preserving Flesh by Smoking—Quick Smoking—Preserving Meat with Salt—Quick Salting by Air Pressure—Quick Salting by Liquid Pressure—Gamgee's Method of Preserving Meat—The Preservation of Eggs—Preservation of White and Yolk of Egg—Milk Preservation—Condensed Milk—The Preservation of Fat—Manufacture of Soup Tablets—Meat Biscuits—Extract of Beef—The Preservation of Vegetable Foods in General—Compressing Vegetables—Preservation of Vegetables by Appert's Method—The Preservation of Fruit—Preservation of Fruit by Storage—The Preservation of Fruit by Drying—Drying Fruit by Artificial Heat—Roasting Fruit—The Preservation of Fruit with Sugar—Boiled Preserved Fruit—The Preservation of Fruit in Spirit, Acetic Acid or Glycerine—Preservation of Fruit without Boiling—Jam Manufacture—The Manufacture of Fruit Jellies—The Making of Gelatine Jellies—The Manufacture of "Sulzen"—The Preservation of Fermented Beverages—**The Manufacture of Candies**—Introduction—The Manufacture of Candied Fruit—The Manufacture of Boiled Sugar and Caramel—The Candying of Fruit—Caramelised Fruit—The Manufacture of Sugar Sticks, or Barley Sugar—Bonbon Making—Fruit Drops—The Manufacture of Dragées—The Machinery and Appliances used in Candy Manufacture—Dyeing Candies and Bonbons—Essential Oils used in Candy Making—Fruit Essences—The Manufacture of Filled Bonbons, Liqueur Bonbons and Stamped Lozenges—Recipes for Jams and Jellies—Recipes for Bonbon Making—Dragées—Appendix—Index.

RECIPES FOR THE PRESERVING OF FRUIT, VEGETABLES AND MEAT. By E. WAGNER. Translated from the German. Crown 8vo. 125 pp. With 14 Illustrations. Price 5s. net. (Post free, 5s. 3d. home; 5s. 4d. abroad.)

Contents.

Part I. Preserved Fruits.—Green Almonds—Gooseberries—Strawberries—Currants—Cherries—Black Nuts—White Nuts—Apricots—Greengages—Pears—Peaches—Plums—Figs—Melons—Apples—Chestnuts—Angelica—Pineapple. **Canned Fruit.**—Gooseberries—Cherries—Apricots—Plums—Rhubarb. **Glazed and Candied Fruits.**—Glazing Fruit—Candied Fruit—Blue Plums—Glazed Chestnuts—Glazed Pineapple Slices—Crystallised Strawberries. **Marmalades, Jams and Fruit Juices.**—Strawberry Marmalade—Cherry Marmalade—Jams—Fruit Jellies—Raspberry Juice—Cherry Juice—Lemon Syrup—Pineapple Juice. **Fruit Pulp for Ices. Citron Peel and Orange Peel. Part II. Preserved Vegetables.**—Asparagus—Peas—Beans—Carrots—Spinach—Artichokes—Tomatoes—Mixed Vegetables—Tinned Julienne—Celery—Mushrooms—Truffles—Pickled Gherkins—Gherkins in Mustard—Mixed Pickles. **Part III. Preserved Meats.**—Veal Cutlets—Fricondeau of Veal—Calves Head—Bouillon Meat—Ox Tongue—Beef à la Mode—Roast Hare—Roast Venison—Mutton and Cabbage—Savoury Paste—Beef Paste—Foie Gras Paste.

Dyeing Fancy Goods.

THE ART OF DYEING AND STAINING MARBLE, ARTIFICIAL STONE, BONE, HORN, IVORY AND WOOD, AND OF IMITATING ALL SORTS OF WOOD. A Practical Handbook for the Use of Joiners, Turners, Manufacturers of Fancy Goods, Stick and Umbrella Makers, Comb Makers, etc. Translated from the German of D. H. SOXHLET, Technical Chemist. Crown 8vo. 168 pp. Price 5s. net. (Post free, 5s. 3d. home ; 5s. 4d. abroad.)

Celluloid.

CELLULOID : Its Raw Material, Manufacture, Properties and Uses. A Handbook for Manufacturers of Celluloid and Celluloid Articles, and all Industries using Celluloid ; also for Dentists and Teeth Specialists. By Dr. Fr. BÖCKMANN, Technical Chemist. Translated from the Third Revised German Edition. Crown 8vo. 120 pp. With 49 Illustrations. Price 5s. net. (Post free, 5s. 3d. home ; 5s. 4d. abroad.)

Contents.

Chapters I., **Raw Materials for the Manufacture of Celluloid :** Cellulose and Pyroxylin—Gun-cotton—Properties of Gun-cotton—Special Gun-cottons for Celluloid Manufacture—Nitrating Centrifugalisers—Collodion Wool—Methods of Preparing Collodion Wool—Camphor — Japanese (Formosa) Camphor, Ordinary Camphor — Borneo Camphor (Borneol), Sumatra Camphor, Camphol, Baros Camphor)—Properties of Camphor—Artificial Camphor—Camphor Substitutes. **II., The Manufacture of Celluloid ;** Manufacturing Camphor by the Aid of Heat and Pressure—Manufacture of Celluloid by Dissolving Gun-cotton in an Alcoholic Solution of Camphor—Preparing Celluloid by the Cold Process—Preparation with an Ethereal Solution of Camphor—Preparation with a Solution of Camphor and Wood Spirit. III., **The Employment of Pyroxylin for Artificial Silk :** Denitrating and Colouring Pyroxylin — Uninflammable Celluloid — Celluloid and Cork Composition—Incombustible Celluloid Substitute — Xylonite or Fibrolithoid. IV., **Properties of Celluloid.** V., **Testing Celluloid.** VI., **Application and Treatment of Celluloid :** Caoutchouc Industry — Making Celluloid Ornaments — Working by the Cold Process — Working by the Warm Process—Celluloid Combs—Celluloid as a Basis for Artificial Teeth — Stained Celluloid Sheets as a Substitute for Glass — Celluloid Printing Blocks and Stamps—Collapsible Seamless Vessels of Celluloid—Making Celluloid Balls—Celluloid Posters—Pressing Hollow Celluloid Articles—Casting Celluloid Articles—Method for Producing Designs on Plates or Sheets of Celluloid, Xylonite, etc.—Imitation Tortoiseshell—Metallic Incrustations—Imitation Florentine Mosaic—Celluloid Collars and Cuffs—Phonograph Cylinder Composition—Making Umbrella and Stick Handles of Celluloid — Celluloid Dolls—Celluloid for Ships' Bottoms—Celluloid Pens—Colouring Finished Celluloid Articles—Printing on Celluloid—Employment of Celluloid (and Pyroxylin) in Lacquer Varnishes—Index.

Lithography, Printing and Engraving.

PRACTICAL LITHOGRAPHY. By ALFRED SEYMOUR. Demy 8vo. With Frontispiece and 33 Illus. 120 pp. Price 5s. net. (Post free, 5s. 4d. home ; 5s. 6d. abroad.)

Contents.

Stones—Transfer Inks—Transfer Papers—Transfer Printing—Litho Press—Press Work—Machine Printing—Colour Printing—Substitutes for Lithographic Stones—Tin Plate Printing and Decoration—Photo-Lithography.

PRINTERS' AND STATIONERS' READY RECKONER AND COMPENDIUM. Compiled by VICTOR GRAHAM. Crown 8vo. 112 pp. 1904. Price 3s. 6d. net. (Post free, 3s. 9d. home ; 3s. 10d. abroad.)

Contents.

Price of Paper per Sheet, Quire, Ream and Lb.—Cost of 100 to 1000 Sheets at various Sizes and Prices per Ream—Cost of Cards—Quantity Table—Sizes and Weights of Paper, Cards, etc.—Notes on Account Books—Discount Tables—Sizes of spaces — Leads to a lb.—Dictionary—Measure for Bookwork—Correcting Proofs, etc.

ENGRAVING FOR ILLUSTRATION. HISTORICAL AND PRACTICAL NOTES. By J. KIRKBRIDE. 72 pp. Two Plates and 6 Illustrations. Crown 8vo. Price 2s. 6d. net. (Post free, 2s. 9d. home ; 2s. 10d. abroad.)

Bookbinding.

PRACTICAL BOOKBINDING. By PAUL ADAM. Translated from the German. Crown 8vo. 180 pp. 127 Illustrations. Price 5s. net. (Post free, 5s. 4d. home; 5s. 6d. abroad.)

Sugar Refining.

THE TECHNOLOGY OF SUGAR: Practical Treatise on the Modern Methods of Manufacture of Sugar from the Sugar Cane and Sugar Beet. By JOHN GEDDES McINTOSH. Second Revised and Enlarged Edition. Demy 8vo. Fully Illustrated. 436 pp. Seventy-six Tables. 1906. Price 10s. 6d. net. (Post free, 11s. home; 11s. 6d. abroad.)

Contents.

Chemistry of Sucrose, Lactose, Maltose, Glucose, Invert Sugar, etc.—Purchase and Analysis of Beets—Treatment of Beets—Diffusion—Filtration—Concentration—Evaporation—**Sugar Cane:** Cultivation—Milling—Diffusion—Sugar Refining—Analysis of Raw Sugars—Chemistry of Molasses, etc.

(*See* "*Evaporating, Condensing, etc., Apparatus,*" *p.* 26.)

Bibliography.

CLASSIFIED GUIDE TO TECHNICAL AND COMMERCIAL BOOKS. Compiled by EDGAR GREENWOOD. Demy 8vo. 224 pp. 1904. Being a Subject-list of the Principal British and American Books in print; giving Title, Author, Size, Date, Publisher and Price. Price 7s. 6d. net. (Post free, 7s. 10d. home; 8s. 3d. abroad.)

THE TECHNICAL BOOKS in this Catalogue can be obtained through all Booksellers, or by post direct from the Publishers by remitting the amount given in brackets.

Full Particulars of Contents of any of the above books will be sent on application.

Books in the Press.—The Publishers will send Contents and prices of books in the press as soon as ready to any one sending their name and address.

Technical Books upon **all Subjects** can be obtained through SCOTT, GREENWOOD & SON, if requirements are fully stated.

SCOTT, GREENWOOD & SON,

Technical Book and Trade Journal Publishers,

8 BROADWAY, LUDGATE HILL,

LONDON, E.C.

Telegraphic Address, "Printeries, London". **Telephone, Bank 5403.**

[*October*, 1907.